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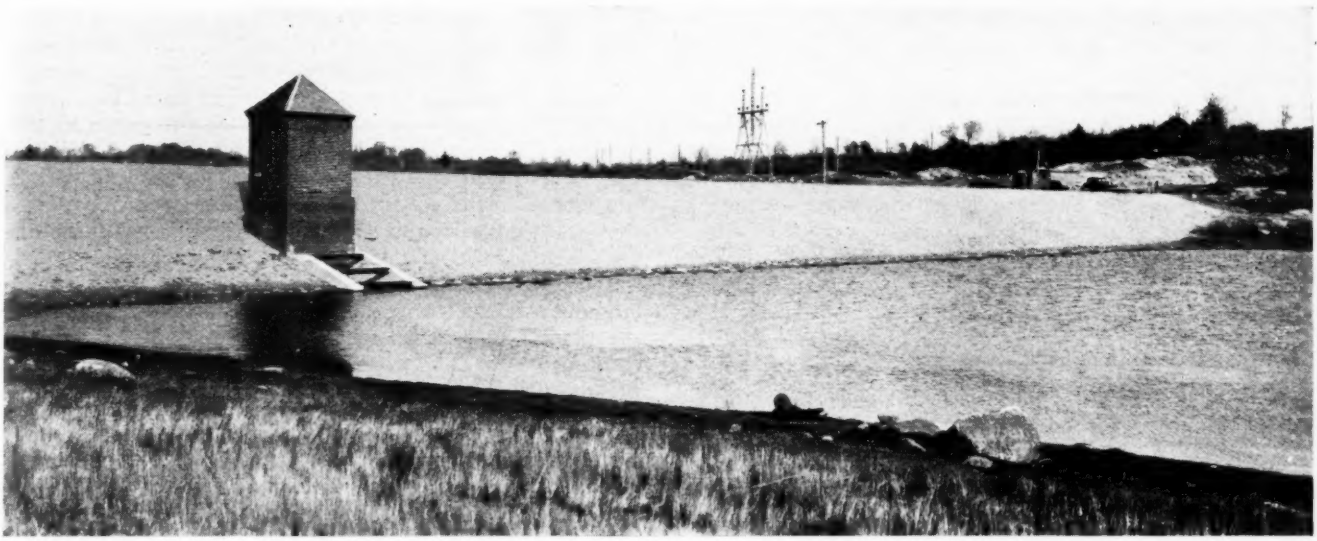


Finished Dam of Leominster Water Works, Leominster, Mass.

Rebuilding a Small Water Works Dam

By W. G. CLASSON

Superintendent Water Works, Leominster, Mass.

THE NO TOWN reservoir dam and dike was built in 1853 by an association of mill owners in Leominster, Mass., to equalize the flow of Monoosnock Brook, which flows through the city. This association was known as the Leominster Reservoir Co. The members were assessed according to the height of their mill privilege, to maintain and operate this reservoir. The privileges in Leominster have 8 to 25 ft. heads, and the power plant of the Fitchburg Gas & Electric Co. had a privilege in Fitchburg, Mass., with 188 ft. fall.

In 1926 the city of Leominster acquired this reservoir as an additional water supply. The power plant in Fitchburg was purchased outright. This gave us Simonds Pond, and 60 per cent interest in No Town Reservoir and Rocky Pond.

Original Dam and Subsequent Improvements.—No Town Reservoir has an area of 237 acres. The capacity is 681 million gallons, with about 5 square miles of drainage area. Several hundred acres of land on the watershed have been purchased.

The original dam (about 600 ft. long) was first built with a wooden flume to control the draft of water, and a spillway 18 ft. wide was provided at the westerly end of dam. The embankment was constructed of sandy earth available in the vicinity and apparently no special precaution was taken to bond it into the natural earth, or make the embankment particularly impervious. No core wall was provided.

In 1876 the flume was removed and replaced by two 24-in. cast iron pipes, a brick gate house was built, and cut off walls placed around pipes.

In 1889 the spillway was lengthened to 24 ft.; in 1893 it was again lengthened to 37 ft. and the height of the main dam and dike were increased to provide 2½ ft. more water. Later the spillway was increased to the present width of 60 ft. Although the spillway had been increased several times, the channel below the spillway was never widened, and was not sufficient to take care of freshet flows.

Improvements Recommended.—In 1928, Mr. Charles W. Sherman of Metcalf & Eddy, Consulting Engineers, Boston, Mass., was employed to make a study and advise the best method of improving conditions.

Mr. Sherman recommended that the channel be increased to full width at once, that the cross sections of dam and dike be increased by grading the down stream sides on 2 to 1 slopes and the water face on 3 to 1 slopes paved with stone at least 12 inches thick.

In the fall of 1928 we started excavating the channel, using the material, which was hard pan, to grade the down stream face of dam. All work was done by hand, with water works men.

Rebuilding Water Face of Dam.—In 1929 a small section of the water face of dam was rebuilt, as an experiment. A concrete cut off wall was placed at the foot of the old dam, the excavation being carried about 2 ft. into hard pan. The cut off wall extended 3 ft. above ground level. From the top of this wall grouted paving was placed on a 3 to 1 slope and then capped with 4 to 6 in. concrete slab. A concrete wall 5 to 6 ft. high was then placed along top line of dam. This formed a substantial core wall. Grading was then done on a 3 to 1 slope which was paved with field stone 12 to 18 in. thick.

In 1930 we changed our methods and drove steel piling (½ in. web weighing 36 lb. per foot), 10 to 20 ft. long into hard pan, the top of piling being left about 1 ft. above ground level at the foot of the old dam. On top of this piling was placed a concrete wall about 3 ft. high. We then proceeded along the lines of the previous year, except that galvanized wire mesh was placed between the grouted paving and concrete slab.

The pile driving was done by Buck-McDonald of Boston, who did a good job in remarkably short time. They were given 28 working days to do the work, but completed it in 11 working days. Seventy-eight tons of steel were used.

All other work was done by water works men and help taken on from the Welfare Department, an average of about 25 men being employed.

Costs.—The cost of rebuilding the dam (1928 to 1931) was as follows:

Excavating channel and grading down stream slope of dam in 1928	$ 3,455.42
Concrete cut off walls, grading and paving small section, 1929	6,351.57
Steel piling in place, grading and paving balance of dam, 1930	16,692.73
Total	$26,499.72

These costs include labor and material, engineering, rental of machinery and use of water works equipment.

Acknowledgment.—The foregoing is an abstract of a paper presented before the New England Water Works Association.

Notes on the Painting of Standpipes

The application of paint to standpipes is discussed in a committee report of the New England Water Works Association, from which the following matter has been abstracted:

Assuming that the surface of the steel plates has been thoroughly cleaned and is perfectly dry, it is ready for painting. This should be begun as soon as possible after cleaning, especially if the plates have been sandblasted, as such surfaces rust very quickly. It is therefore customary to clean only as much surface with the sandblast as can be painted on the same day.

Standpipe Interior.—In order to get a hard moisture-resisting film for the inside of the tank, the paint should contain as large a proportion of pigment as will produce a workable paint—that is, one that can be brushed out into a thin film. This is especially important if boiled oil is used; for in this case a thick film would require a very long time to dry and would be liable to be destroyed by the water, even if it seemed dry when the tank was filled. Fine grinding and intimate mixture of the pigment and vehicle by machines, as in the manufacture of pastes and ready-mixed paints, are great aids to securing a thin, uniform film. The first and succeeding undercoats should not dry with a high gloss, as paint will not adhere well to this kind of surface.

A large proportion of pigment to vehicle tends to reduce gloss, and a little turpentine makes the paint more workable and produces the desired dull surface. The last coat should not contain turpentine, as a glossy surface is desirable, if not obtained at the sacrifice of hardness in the film. A small proportion of finely-ground litharge added to all the interior coats seems to increase the hardness and waterproof qualities and hastens the drying of the paint, particularly if red lead is the pigment.

The addition of a very small amount of lampblack paste to red-lead paint produces a light chocolate color suitable for the second coat. A darker shade for the third coat may be obtained by an increased proportion of lampblack.

Standpipe Exterior.—The outside paint film does not need to be so hard as that for continuous under-water exposure, although in hot, humid weather there is a film of condensed moisture over the part of the standpipe which is filled with water.

The first coat should be the hardest. Each succeeding coat should be slightly more elastic than the one to which it is applied, in order to avoid elastic under-coat cracks. The final coat should dry with a gloss, as this increases the durability.

Red lead and raw linseed oil with driers and a little turpentine make a very good priming coat. Owing to the bright color of red lead, it is necessary to follow this coat with two coats, if white or light-colored paint is to be used. A little litharge, about one-third of the amount used in the red lead for inside work, expedites the drying and increases the hardness of the red-lead priming coat. It is good practice to have each coat of paint differ in shade or color from the one to which it is applied, in order to facilitate inspection.

On new work, at least three coats of paint should be applied. On a repaint job, the condition of the surface is often the controlling factor. If after thorough cleaning there is a large proportion of firmly-adhering old paint, touching up bare places followed by two coats for inside work and one coat for the outside, if the standpipe is enclosed in a building, may be sufficient. If little or none of the old paint survives the cleaning process, three coats should be applied.

Quantity of Paint Required.—The determination of the quantity of paint required for a standpipe is rather difficult, as there are numerous factors that affect the result. Some of these are the kind of pigment and the degree of fineness to which it is ground, the character of the vehicle, the method of mixture with the pigment, the proportion of the latter to the vehicle, the condition of the surface as to smoothness and the method of application—whether flowed on in a full coat or well brushed-out. A sandblasted surface on new steel plates will take much less paint than a rough, pitted surface, even if well cleaned.

In general, a gallon of paint made with red-lead paste and boiled linseed oil will cover about 700 sq. ft. on a sandblasted surface and about the same area with the succeeding coats. If the surface is quite rough, it may take twice as much paint to cover the same area. Outside coats will cover from 600 to 700 sq. ft. per gal., according to conditions.

Regarding the durability of red-lead paint, mixed in the right proportions and carefully applied to a properly prepared surface, a life of from seven to ten years may be expected for paint on the inside of standpipes protected by structures. Probably the life would be somewhat less for unprotected tanks, especially in the northern part of the country. The outside of standpipes in exposed locations may require repainting sooner.

It is evident that the majority of painting jobs on standpipes have a much shorter life, often three years or less, but in such cases it will generally be found that some or all the conditions necessary for good work previously mentioned are not fulfilled. Adequate supervision, good workmanship and proper materials are necessary, if the best results are to be obtained.

The durability of bituminous coatings applied hot is subject to the same conditions as to preparation of the surface, suitable materials and proper application, as in the case of paint coats.

Controlling Filter Bed Growths with Chlorinated Lime

Method of Correcting a Troublesome Growth on the Filter Beds Caused by the Presence of Cannery Wastes in the Sewage

By WILLIAM A. RYAN
Sanitary Chemist, Rochester, N. Y.

ALBION, New York, the county seat of Orleans County, is a residential village of approximately 5,200 population. Its chief industries are canning factories and a vinegar plant.

The sewage plant was redesigned in 1929 by John F. Skinner of Rochester, N. Y. Previous to this time the plant consisted of an Imhoff tank and two contact beds. The main reason for the failure of the first plant to function properly was the presence of considerable amounts of vinegar and cannery wastes in the sanitary sewage.

The Treatment Plant.—The Albion sewage treatment plant now consists of a five hopper Imhoff tank and two trickling filter beds followed by two final settling basins. The sewage passes through two rough racks before entering the tank. The first rack has 1 in. openings and the second rack has 11/16 in. openings. The tank effluent is lifted to the siphon chamber by an air lift. The trickling filters, each of a 0.175 acre area, are separated by a pipe gallery, 6 ft. wide inside and 7 ft. high, extending the full length of the filters. The pipe gallery contains two 12 in. cast iron main distributors, one for each filter unit, together with 20 5-in. control valves—one for each lateral distributor. The depth of the filtering material is 6 ft. and the media consists of uniform size limestone. The operating house, in which the motors and compressors are installed, consists of a stuccoed, hollow tiled superstructure, 10 ft. by 29 ft. outside dimension.

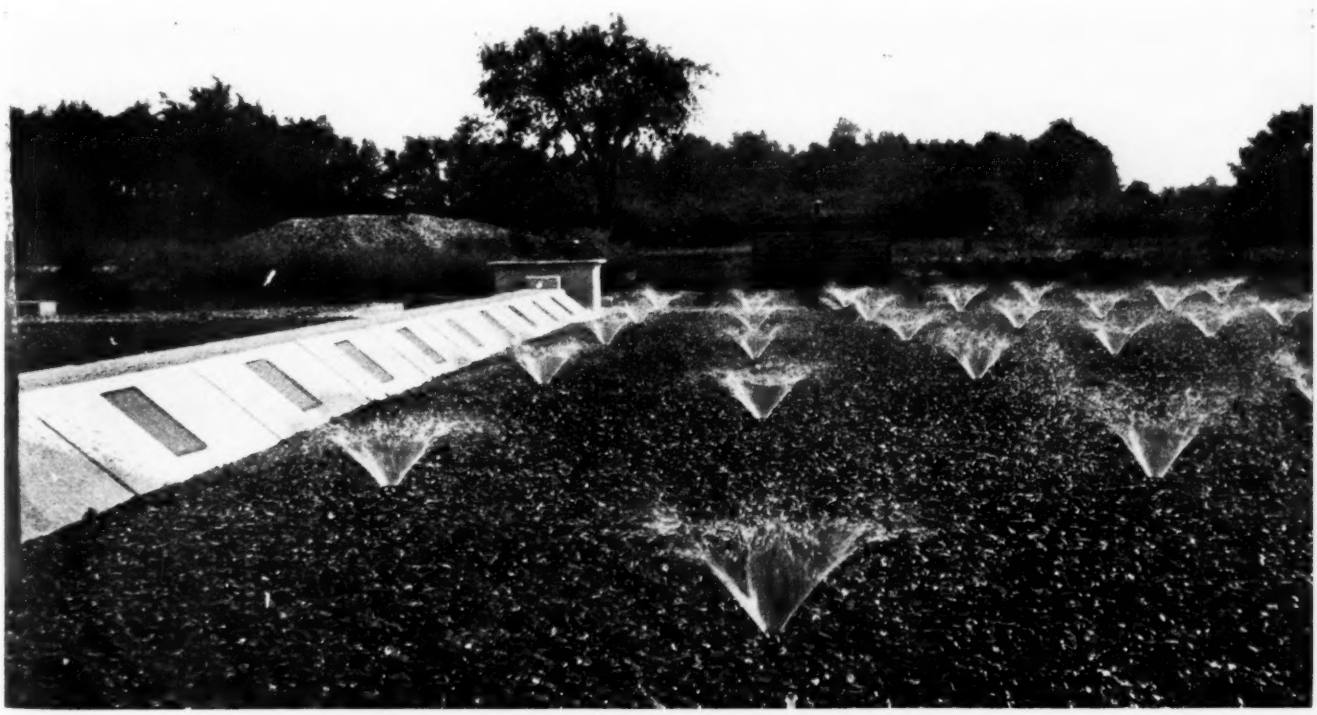
An analysis of raw sewage collected Sept. 9, 1929, follows:

pH Value	6.0	
Acidity	235	
Dissolved Solids	1850	P. P. M.
Loss on Ignition	1266	"
Suspended Solids	535	"

From the above figures, it can be readily seen that the sewage was far from satisfactory for treatment. The source of the waste was found to be a vinegar plant which used molasses as their raw product. The practice of dumping this waste in the sewer has been discontinued.

The sewage was again analyzed on Feb. 4, 1930, as follows:

Total Solids	687	P. P. M.
Suspended Solids	124	"
Dissolved Solids	563	"
Chlorides (Cl_2)	49	"
Free Ammonia (N)	8	"
pH Value	7.3	
Dissolved Oxygen	0	"
B. O. D. 24 hours	48	"
B. O. D. 120 hours	100	"
Total Count Agar Media 24 hours at 37.6 C.	480,000.	
B. Coli—E. M. B. Media	20,000.	



Filter Beds at Sewage Disposal Plant of Albion, N. Y.

This analysis indicated that the wastes had been removed from the sanitary sewage. As a physician might say "The fever had left the patient," and we were quite optimistic about the chances of the plant surviving.

During the early months of 1930 the sewage received primary treatment and in July, 1930, the filter beds were placed in service. Everything went well until September when it was discovered that cannery wastes were present in the sewage entering the plant.

At the suggestion of Mr. C. R. Cox, Sanitary Engineer of the New York State Health Department, calcium hydroxide was added intermittently during the day to the amount of 50 lb. every 24 hours. This method had been used successfully at the Snyder Packing Company waste disposal plant by keeping the pH value at 10 or above. We were not able to raise the pH value of the sewage entering the filter beds above 8.4 through the use of small amounts of lime.

The fungus growth on the filter beds had developed to such an extent by Nov. 1 that the whole surface was covered with what appeared to be tomato pulp. It was light red in color and grew so profusely that the beds pooled badly. The tile drain pipes, leading from the filter beds to the secondary tanks, were likewise partly coated with a fungus growth.

How the Trouble Was Corrected.—The plan of attack decided upon was as follows: Fifty pounds of calcium hydroxide was to be added to the raw sewage daily and chlorinated lime (bleaching powder), 35 per cent available chlorine content, was to be spread over the surface of the filter beds until all the surface should receive one application. Twelve hundred pounds of calcium hydroxide was added to the raw sewage and approximately 450 lb. of chlorinated lime was spread over the surface of the filter beds during November.

The filter effluent averaged 7.6 pH value during the period of treatment whereas it was much lower, averaging 7.0 or less during the months of August and September. The stability and nitrates increased and every trace of excessive surface film of fungus was destroyed; likewise, the growth in the discharge tile was destroyed.

The film on the stones below the surface was not disturbed to any extent. The filter beds had not been in service a sufficient length of time to have the natural fauna, characteristic of normal filter beds. From Dec. 1, 1930, to March 1, 1931, the stability of the final effluent has been 14 days plus and the nitrates have averaged 4.5 P.P.M.

It is planned to continue the use of bleaching powder from time to time to destroy excessive surface film. The writer has had success in hastening the destruction and removal of surface film from a filter bed at the Brighton Treatment Plant through the use of liquid bleach containing 15 per cent available chlorine and 16 per cent caustic soda.

Summary.—Chlorinated lime plus lime corrected a troublesome condition on the filter beds which was caused by the presence of cannery wastes in the sewage at Albion, N. Y.

What effect lime, caustic soda, or other compounds of an alkaline nature exert when used with chlorine or hypochlorites needs to be studied more thoroughly before drawing definite conclusions.

The writer wishes to acknowledge the assistance of Mr. Frank Nayman, operator of the Albion sewage treatment plant, in carrying on the above experiment.

Municipal Bond Election Results During March

New state and municipal bond issues reported approved by the voters of 93 communities during March totaled $46,610,994, as compared with $33,741,500 in March of 1930, $22,154,465 in 1929 and $21,636,502 in 1928, according to *The Daily Bond Buyer,* of New York. This is the largest March total ever reported and is accounted for largely by a $13,000,000 authorization by the Chicago Sanitary District and a $12,720,000 project by the Los Angeles, Calif., school districts. Other important items include $5,000,000 City of Los Angeles, Cal.; $1,500,000 Jefferson Co., Ala., and $3,250,000 Lancaster, Pa.

During the same period the voters of 39 communities in 16 states rejected proposals to authorize new issues totaling $6,500,000, as compared with $10,536,000 in March, 1930; $10,103,250 in 1929, and $11,107,340 in 1928. Among the larger items were $1,000,000 Wichita Falls, Tex.; $900,000 Howard Co., Tex.; $700,000 Sioux City, Ia., Independent School District, and $500,000 Spokane, Wash.

The following table, compiled by *The Daily Bond Buyer,* presents a comparison of bonds approved by months for the past three years:

	1931	1930 (.000 omitted)	1929
January	$ 8,326	$ 11,620	$ 26,950
February	48,300	17,861	13,309
March	46,610	33,741	22,154
April	.....	45,325	37,963
May	.....	56,823	61,852
June	.....	13,414	53,711
July	.....	14,628	35,895
August	.....	3,369	16,540
September	.....	8,590	85,308
October	.....	4,136	21,760
November	.....	405,976	48,499
December	.....	10,461	17,002
Total	$103,237	$626,059	$420,995

The Water Department and Civil Service

So far as its personnel is concerned, the Water Department is particularly well suited for administration on civil service basis. Its problems, as has been said, are largely technical, with the exception of laborers employed in the work of construction, extensions or repairs. The employees of a water department are entrusted with functions that require both skill and integrity. Miscalculations in water supply engineering, errors in water analysis, and mistakes in water accounting are all easy to make, and they are almost sure to occur with costly repetition unless the city takes reasonable precaution to keep political patronage out of the department. It seems an utter absurdity that we should ever tolerate the influence of the political spoilsman upon such far-reaching matters as the adequacy and safety of water supply, the engineering of pumps, mains, and pressure, and the highly technical questions of water analysis and purification. Practically every regular position in the city's water department carries a duty of a definable nature, whether or not an aspirant possesses these qualifications can be determined with reasonable certainty by means of careful examination. Every position should be filled in this way and the one so selected should be given proper security of his position and not be removed through political influence. —Extract from the annual report of J. W. McEvoy, Superintendent of Water Works of Dubuque, Ia.

FILTRATION PLANTS

A Section Dealing with Their Design, Construction and Operation

Conducted by JOHN R. BAYLIS, Associate Editor
Physical Chemist, Bureau of Engineering, Chicago, Ill.

Settling Basins for Coagulated Water

Continuation of the Article from the March Issue

THE use of continuous sludge-removing devices in water treatment started about 1923 when the softening and iron removal plant at Benton Harbor, Mich.,[71] was put into service. The water from the mechanical mixing basin goes to a circular tank equipped with a Dorr continuous sludge-removing device commonly called a "clarifier." The tank has a settling time of about 1 hour at rated capacity of the plant. This is followed by a period of about 8 hours settling in rectangular concrete basins. The municipal softening plant at Newark, O.,[72] was the second plant to install a continuous sludge-removing device. This plant was put in operation in 1924. The tank is circular, 40 ft. in diameter, and about 8 ft. deep, with a conical bottom sloping towards the center. The flow through the tank is radial, the softened water ladened with the sediment from the mixing tank enters at the top and center and the clear water overflows around the circumference. The retention period is about 22 minutes at nominal capacity in the continuous sludge remover, which is followed by a settling period of about 8 hours in rectangular basins.

Most of the basins equipped with continuous sludge removing devices have used the Dorr equipment. Illustration of a typical sludge-remover is shown in Fig. 2. The device has slowly revolving rakes located very close to the floor of the basin which gradually move the sediment toward the center. The rakes or plows are set on an angle and located close enough so that the sludge

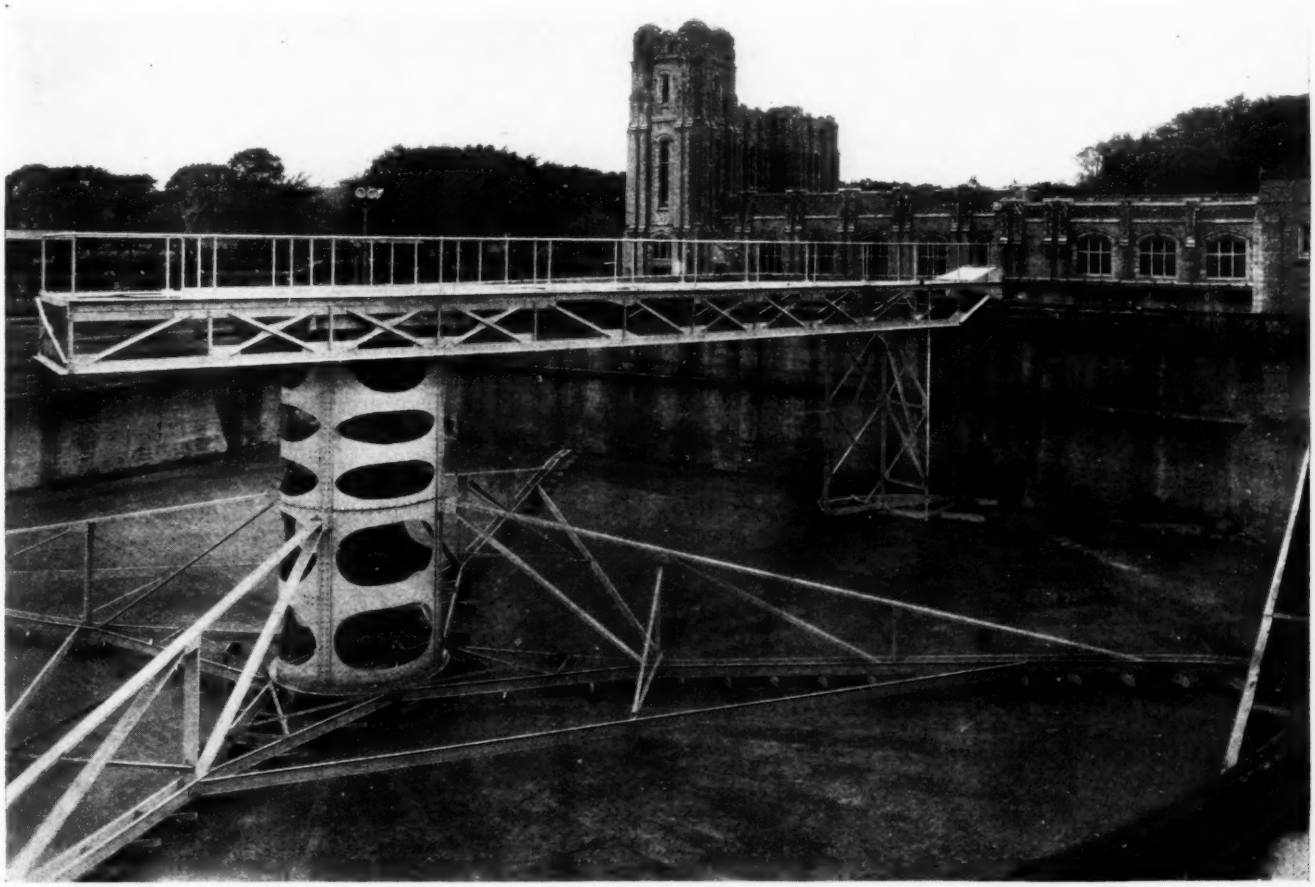


Fig. 2.—Dorr Clarifier at Cedar Rapids, Ia.

moved forward by one rake is moved by the next rake on the next revolution, or with the next arm that passes. While only one arm may extend to the sidewall of the tank, there are usually one or more arms that extend out part of the distance from the center. The settled solids are scraped into an annular depression around the center pier, and runs to waste through a drain pipe with a control valve. The traction type made for use in square basins came into use a few years ago and will likely be the type most extensively used for large basins.

The continuous sludge removers were first used in water softening plants and in sewage disposal plants. Now such devices are being used for removing the sediment from preliminary settling basins where the water is very turbid, as well as for removing the sediment where the water is softened or where it is treated with a coagulant. One of the first sludge removers for water treated only with a coagulant was installed at Lancaster, Pa., in 1926. This was a traction type for an 80 ft. tank. The water treatment plant at Mamaroneck, N. Y., which was put in operation in 1929, a plant using a coagulant only, also is equipped with a Dorr sludge remover. There is a settling period of one hour in the basin equipped with a continuous sludge remover, which is followed by two hours settling in rectangular concrete settling basins.

The use of continuous sludge removers is being extended rapidly to softening plants. Very few softening plants of moderate or large size are now being constructed without such equipment. Table III gives a list of plants with continuous sludge-removing devices and the year installed. A return of part of the sludge to the mixing basin is now being practiced at several plants. This very likely will become common practice within the near future for softening plants.

What Should be Accomplished in the Settling Basins.—That the coagulated water should be settled to the point where it can be handled satisfactorily by the filters, every one will agree. However, no one seems to know how to predict this point for a given water with a given treatment. As a matter of fact, there are so many factors affecting the amount of coagulated matter a filter bed will remove before becoming clogged, or before coagulated matter begins to pass through the bed, it is impossible for all of these factors to be determined in advance. The best we can do at the present time is to settle the water so thoroughly there will not be much possibility of the filter beds becoming overloaded to the extent that coagulated matter will pass on through within a very short time or that the filter runs will be unduly short. Fortunately the cost of sedimentation is usually so low that it is economy to have fairly good removal of the coagulated matter.

Table III.—Continuous Sludge-Removing Devices in Water Treatment Plants.

Ref. No.	City	Design Flow M.G.D.	No. U'ts	Size Ft.	Yr. in-stall'd	Type of Treatment
71	Benton Harbor, Mich.	2.0	1	29	1922	Softening
72	Newark, Ohio	6.0	1	40	1922	Softening
	South Pittsburgh, Pa.	20.0	1	85	1923	Softening
30	Miami, Fla.	10.0	1	60	1924	Softening
		20.0	1	109	1928	Softening
	Greenville, Ohio	1.0	1	22	1925	Softening
46	Springfield, Ill.	10.0	2	63	1925	Softening
73	Hinsdale, Ill.	2.0	1	29	1925	Softening
74	Piqua, Ohio	5.0	1	50	1925	Softening
	Wisconsin Rapids, Wis.	1.0	1	25	1925	Iron remov'l
	Decatur, Ill.	18.0	1	84	1926	Softening
	Lancaster, Pa.	12.0	1	80	1926	Coagulation
	Midland, Mich.	2.0	1	30	1926	Softening
	Wausau, Wis.	3.4	1	45	1927	Coagulation
44	St. Louis, Mo., Howard Bend	80.0	2	150	1927	Softening
75	Marion, Ohio	5.0	1	120	1927	Softening
76	Beverly Hills, Calif.	5.0	1	60	1927	Softening
77	Fremont, Ohio	3.0	1	40	1927	Softening
	Boca Raton, Fla.	.5	1	45	1928	Softening
10	Cedar Rapids, Iowa	12.0	1	100	1929	Softening
	Kankakee, Ill.	8.0	1	55	1929	Softening
	Bloomington, Ill.	..	2	70	1929	Softening
78	Saginaw, Mich.	25.0	2	64	1927	Softening
	Blackwell, Okla.	..	1	30	1927	Softening
79	Mamaroneck, N. Y.	6.0	1	60	1929	Coagulation
	Ashland, Ky.	4.5	1	75	1930	Coagulation
	Findlay, Ohio	4.0	2	50	1930	Softening
	Warren, Ohio	4.0	1	55	1930	Softening

Ellms (Water Purification, Second edition, page 361) gives a curve showing the maximum effective rate of filtration for different turbidities of applied water. This curve shows for a turbidity of 60 for the applied water the rate of filtration should not be greater than 1.2 gal. per square ft. per minute. For the 2-gal. rate which is customary rating for rapid sand filters, the turbidity should be not greater than 43, and for a turbidity of 10 the rate might be about 3.2 gal. The curve was prepared by Streeter from results obtained at the Clarksburg, W. Va., plant. There is no doubt about the curve being in the direction indicated, but for some plants it might vary considerable from the one given by Ellms. The turbidity is only one of the factors that cause the coagulated matter to pass through the filter beds. In addition to this curve, Ellms (page 384) gives another curve showing the average yield per foot loss of head for different turbidities of applied water. This curve shows that for a turbidity of 43 for the applied water, it should yield about 310 gal. per square foot per foot loss of head. If the maximum loss of head is 8 ft. over the initial loss, the yield should be about 2,480 gal. per square foot. At a rate of 2 gal. per square foot per minute, the run would be 1,240 minutes, or 20.7 hours. This is not far from what one might expect for a turbidity of 43 when the water is free from materials that reinforce the flocculated matter, such as microorganisms. This is with sand of from .35 to .40 mm. diameter for the 10 per cent size.

With all factors equal, except the sand size, the variation in sand size will effect the length of the filter run or the rate at which the loss of head increased. Temperature probably has a material effect, but the greatest effect is produced by the character of the suspended matter, where there is not much variation in the said size as is the case for most rapid sand filter beds. The curves shown by Ellms probably are nearly correct for certain conditions but are not for waters containing an abundance of microörganisms.

Filter runs should be in excess of 36 hours, unless it requires some unusual treatment to produce this length of run. When the runs are shorter than 24 hours the slight increase in turbidity passing the filters immediately after washing becomes a serious factor. To run the water to waste long enough for the water to become perfectly clear, requires wasting considerable water, and to run it into the clear water reservoir immediately without filtering to waste increases the turbidity of the filtered water. The writer[80] has shown that it takes a filter more than an hour after washing to reach its maximum efficiency in the removal of turbidity. Most rapid sand filters will pass a turbidity ranging from 0.5 to 1.5 for a period of 10 to 15 minutes after washing. If the turbidity averaged about 0.6 for the first hour, as was the case for the curve shown by the writer, this gives an average increase of 0.05 to the total water filtered

when the runs are 12 hours and 0.025 when the runs are 24 hours. It is readily seen that the runs should not be less than 24 hours if such runs may be obtained at a reasonable cost. Not only this but the wash water will be less for the longer runs, but probably not in a direct ratio.

The writer is of the opinion that under all conditions it will be economy to settle the coagulated water below turbidity of 20, under nearly all conditions it will be economy to settle below turbidity of 10, and under average conditions it will be economy to settle to a turbidity of 5 or less. This does not mean that a poorly designed plant should attempt to settle to a turbidity of 5. To reduce the turbidity leaving the settling basins to 20 in some plants might require an amount of coagulant so greatly in excess of that just sufficient to coagulate to where it will filter clear that one would not be justified in increasing it so highly. It would be economy, however, to construct a more efficient settling basin, and also a more efficient mixing basin if lack of proper flocculation is part of the trouble. It requires the combination of a good mixing and good settling basins to bring about the most efficient results.

Flow through Settling Basins.—There is no means of predicting accurately the course water will take in flowing through a settling basin. The water comes from the mixing basins through pipe or conduits at a velocity from about 0.5 to 2.0 feet per second. Based upon theoretical displacement in the settling basins, the velocity would be from about 0.5 to 5.0 ft. per minute. To reduce the mixing basin velocity to that of the average for the settling basins is a difficult task. In fact it is something that cannot be fully accomplished. The best we can hope to do is to materially check the velocity. There must be a transition stage that requires both time and distance. The first checking of the velocity is usually accomplished by letting the water from the pipes or conduits flow into an enlarged section, which, in some instances, is just a short section of the settling basin walled up with a baffle so as to direct the water into the main basin more slowly and more uniformly along the entrance end. In most of the smaller plants the entrance is over a baffle that is one side of a trough built across the entrance and near the surface as shown in Fig. 1. The water flows into the trough near the bottom in the direction of the flow in the settling basin, strikes the baffle wall, and is deflected upward and sideways. The top of the baffle is usually about 12 to 18 in. below the water surface. Should the basin be 16 ft. deep, and the depth over the baffle 18 in., the entrance velocity would be nearly eleven times the velocity in the basin if it was uniform throughout the entire area.

Sometimes the baffle is a slotted wall, or a wall with a number of perforations. There are various opinions as to which type of entrance is the best. Certainly none of them produce the ideal condition, that is reduce the velocity to where it will flow through the basins in a uniform velocity. The writer will not attempt to change the ideas of the various designing engineers as to the best type of entrance to use. Where the settling basins are over 400 ft. in length it probably makes little difference how the water enters so long as there is some effort to distribute it uniformly along the entrance end. It is the short basins where there is the greatest danger of short-circuiting. Frequently a basin not over 100 ft. in length has from 2 to 4 hours settling time. It may be possible to materially reduce the entrance velocity, but to reduce it to where there is uniform displacement of the water is impossible, for it would then be less than 1 ft. per minute. By special baffling arrangements it may be possible to reduce the velocity of the water flowing at maximum velocity to near 5 ft. per minute, which will mean that some of the water will reach the outlet within less than one-half the theoretical settling time.

The writer has had occasion to make a number of observations on the flow of water through large settling basins and through very small basins. The observations have covered a wide range of turbidities. The flow of water with high turbidity, or heavy sediment such as is produced when the water is softened by chemical precipitation, is the most difficult to control. There is no way in which such water can be directed uniformly across the settling basin. It has a slightly higher specific gravity than that of fairly clear water, and regardless of how it is directed into the basin it will quickly go to near the bottom of the basin. The sediment being heavy, it settles out rapidly, but the water flows forward, perhaps in some instances at 5 to 10 times the theoretical velocity. What usually happens is the water on the surface flows in the opposite direction of the flow through the basin, that is, the clearer water on top is turning over and over. It is evident if highly turbid water is to be handled at times, the basin should have some form of cross baffling, or the water should pass through two or more basins in series. It is probable that continuous sludge-removing devices will be used in practically all plants designed for handling highly turbid water in the future. That is rapidly becoming almost the universal practice for softening plants.

When the turbidity of the raw water is less than 50, and the water is treated with a coagulant only, the specific gravity is so near that of the clarified water that this is not a factor to be taken into consideration in directing the flow through the settling basins, but where it is above this figure it becomes more and more difficult to direct the flow. It is believed that the best design for the entrance to fairly long basins where the turbidity is high is to direct the water over a baffle in such a manner that the overturning will be in the opposite direction of the way it usually occurs. It is best to give the water an entrance velocity of 0.3 to 0.5 ft. per second over a baffle sloping at the top so that the force of the water will always be directed against the surface of the water. Then the water a few feet from the entrance end will be flowing forward at the surface with a fairly high velocity; which will cause the water near the bottom to flow in the opposite direction. It is evident that the highly turbid water will not flow very far before it begins to work its way downward, but much of the heaviest sediment will have been removed before it moves forward very far, and it will not have so great a tendency to pull itself to the bottom and flow along the bottom. With one or more cross baffles to direct the flow upward at certain points, the water usually can be settled to the desired turbidity before reaching the outlet.

Armstrong[81] gives a very good description of the erratic flow through the settling basins at Baltimore. There are two settling basins in the old plant, each 317 ft. long, 232 ft. wide, and an average depth of water of about 15 ft. One-half of the water flows through one basin and the other half through the other. The water passes over a baffle at the entrance and over a skimming weir at the exit. A center wall extends about three-fourths of the length of each basin. Float tests were made on one of these basins with floats suspended just below the surface. The floats were made of sheet aluminum 6 in. x 12 in. A small weight was fastened to the lower end of the float and a cork was fastened to

the other end. The float was suspended just beneath the surface and nothing but the cork was exposed to the air, so it is not believed that the wind affected the floats to any material extent. In fact, the tests were made on days when the wind velocity was very low.

The basins had been cleaned three days prior to the time tests were made. Armstrong gives a diagram of the basin showing the course the floats followed. Five floats were inserted 10 ft. apart at the entrance end. One of them floated back and forth and never moved forward in the basin more than about 60 ft. The other four moved over close to the center baffle and then moved forward at a velocity ranging from 2 to 12 ft. a minute. The theoretical velocity through the basin at the time the tests were made was about 3.5 ft. per minute. This shows that the floats did not follow a uniform course through the basin. The floats were confined to the direction of flow at the surface and do not give a very good indication of the true direction of the water, for it must flow upward and downward as well as taking an irregular horizontal course.

Observations on the flow of water which has been softened by the addition of lime to the extent that a very heavy precipitata was produced, proved interesting. The water entered the basin over a baffle at the surface, was deflected downward and then passed over another baffle which was located a short distance from the entrance end. This baffle extended from the bottom up to about one-half the depth of the water. The treatment left the water so clear after a very short period of sedimentation that the flow of water containing the heavy sediment could be watched, even though it was 8 or 10 ft. below the surface. The water after passing through the entrance baffle dropped directly downward to near the bottom of the basin, flowed along the bottom to the submerged baffle, raised up in a nearly vertical direction by the side, passed over the top, and then flowed downward on the other side in a nearly vertical direction. Then it flowed along the bottom of the basin to the outlet where it came up to the overflow weir in a nearly vertical direction. The water on the surface of the basin flowed in the opposite direction to that of the water underneath. The theoretical settling time in this basin was about one hour and even though some of the water passed through it within 10 or 15 minutes there was a reduction of about 90 per cent in the suspended matter in passing through the basin. The water from this basin flowed to a second settling basin where it passed through with a more uniform velocity, at least there was no tendency for the water coming into the second basin to flow to the bottom as was the case for the first basin. These observations show how foolish it is to make any unusual preparations for directing the flow of the water containing a large amount of sediment. Check the entrance velocity as much as is practicable and let it take its own course until a large per cent of the sediment is removed, then direct it into a second basin or a second compartment of the first basin where it can then flow forward more uniformly than is possible for it to do in the first basin or the first part of the first basin.

Cross Baffling of Settling Basins.—The main advantage of cross baffling is that it brings the partially settled water up to the surface so as to prevent the overturning referred to under the discussion on flow through settling basins. It is usually a wall built across the settling basin from the bottom to a point several feet below the surface of the water. The location of the baffle varies, depending on the length of the basin and the ideas of the one having it installed. Cross baffling may be of great value for highly turbid water or for water containing a heavy sediment such as the precipitate produced by lime and soda softening. Armstrong[82] shows that there was considerable value in cross baffling one of the settling basins at Baltimore before the large storage reservoir was constructed. The raw water prior to the construction of this reservoir was occasionally quite turbid. The basin was 317 ft. long and 232 ft. wide, with a concrete wall extending along the center for a distance of about three-fourths the length of the basin. This formed a typical "around the end" type of basin. The first cross baffle was constructed 231 ft. from the entrance end of the basin. This was within a few feet of the end of the center concrete wall. The baffle was made of wood and extended from the bottom to a point about 4.3 ft. below the water level. This gave an average velocity over the baffle of about 0.35 ft. per second. A second wooden baffle was constructed on the return side of the basin about 165 ft. from the outlet of the basin. The depth of the water over this baffle was about 5.5 ft.

A profile of the mud line in the Baltimore basin shows that the cross baffles were effective in holding the mud deposits back in the first part of the basin. Armstrong states that: "The observations seem to indicate that a velocity from 0.35 to 0.40 ft. per second over the top of the baffle will give fairly uniform flow, which will secure nearly equal subsiding values in all parts of the basin. . . ." As baffles were constructed in only one of the basins at Baltimore there was excellent opportunity to compare with a basin not baffled and handling the same water. Armstrong also states that the results of the baffled basin were markedly better than from the basin without cross baffles. In times of high turbidity the difference in the effluent from the two basins was so great it presented a marked contrast to the eye.

The writer observed a settling basin at Abilene, Tex., in a softening plant which was cross-baffled in a manner somewhat unusual. Two walls were constructed very close together, one extending from the bottom of the basin to a short distance beneath the surface of the water, and the other extended from a point above the water line to a point near the bottom. The water from the first section of the basin flowed over the top of the submerged baffle and down to near the bottom back of the second wall. If the writer's memory is correct there were two such cross baffles. Diverting the flow back downward is contrary to what one might expect would give the best results where the water is treated with a coagulant only, but it seemed to be producing good results in the softening plant. Veatch[83] describes an installation at Topeka, Kan., for a turbid water that is somewhat similar. From the mixing chamber the water flows by gravity into the settling basins, two in number, with a combined capacity of 1,950,000 gal., or six hours flow for the nominal capacity of eight million and from 10.6 to 12.5 hours flow for the draft during 1923. The basins are operated in parallel and are filled with skimming weirs at each end and "A" frame baffles in the center. The water depth is 16 ft. and the average velocity in the basins during 1923 from 0.15 to 0.18 ft. per minute.

Failures in Settling Basins.—There has been enough failures in the walls and bottoms of settling basins to urge that more consideration be given to settling basin design. It seems that the engineers think more about making the basins safe when full of water and frequently neglect to make it safe when empty, or safe when one basin is full and the other empty. It is almost impossible to construct a bottom that is perfectly water-

tight, consequently the foundation frequently becomes saturated with water after long use of the basins and materially reduces the holding power of the ground upon which the structure is built. Most of the failures of walls have been the wall between the two basins. There has been enough failures in this part of the structure to justify some radical departure from present practice. Probably such failures could be prevented by extending a curtain wall down some distance below the bottom of the basin to prevent water getting underneath the wall. Regardless of what is necessary the structures should be designed so they are safe.

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Checking Straightness of Deep Wells

A method for testing well bores was discussed by Frank J. Link, president J. P. Miller Artesian Well Co., Chicago, in a paper presented at the Third Annual Convention of the Illinois Well Drillers' Association. The method as cited by Mr. Link was as follows:

Experience has shown that an effective method for testing and checking the straightness, plumbness and circular cross-section of a well bore is by the use of a dummy 80 ft. long, made up of four 20-ft. lengths of pipe turned and flanged at each end so that the axis of the pipe and faces of the flanges are truly perpendicular. When bolted together, the dummy should be straight and true for its full length of 80 ft. with flanges at each end and one at each of the quarter points.

The diameters of the flanges should not be smaller than ½ in. less than the size of the well or inside diameter of the casing. A dummy of this construction should pass freely in or out of the well or pipe and would thus determine definitely the straightness and circularity of the well.

The rings should be at right angles to the vertical axis of the dummy. The dummy should be lowered into the hole and shall move freely without binding to the depth required. Should the dummy fail to move freely throughout the required length designated, the well should be corrected.

State and Municipal Borrowing in March

An unusually large total of state and municipal financing is reported for the month of March. As estimated by *The Daily Bond Buyer,* of New York, flotations during the past month aggregated $275,087,936. This large figure is in sharp contrast with the two preceding months, when new issues amounted to $119,588,000 (in February) and $49,977,000 (in January).

Only twice before in the history of domestic municipal finance has the March, 1931, total been exceeded. In December, 1929, and in June, 1924, new loans aggregated slightly in excess of $286,000,000.

The following table prepared by *The Daily Bond Buyer* of New York compares municipal bond sale totals in March for the past ten years:

	March	3 mos. ending March 31
1931	$275,087,936	$444,653,949
1930	127,028,127	297,952,139
1929	109,055,775	271,159,658
1928	132,897,209	368,760,730
1927	92,068,518	339,425,212
1926	117,631,739	339,138,892
1925	110,489,694	310,195,255
1924	103,134,539	291,074,032

The Four D's of Sludge

The Four Essentials of Good Sludge Practice: Deposition, Digestion, Drying and Disposal

By MORRIS M. COHN

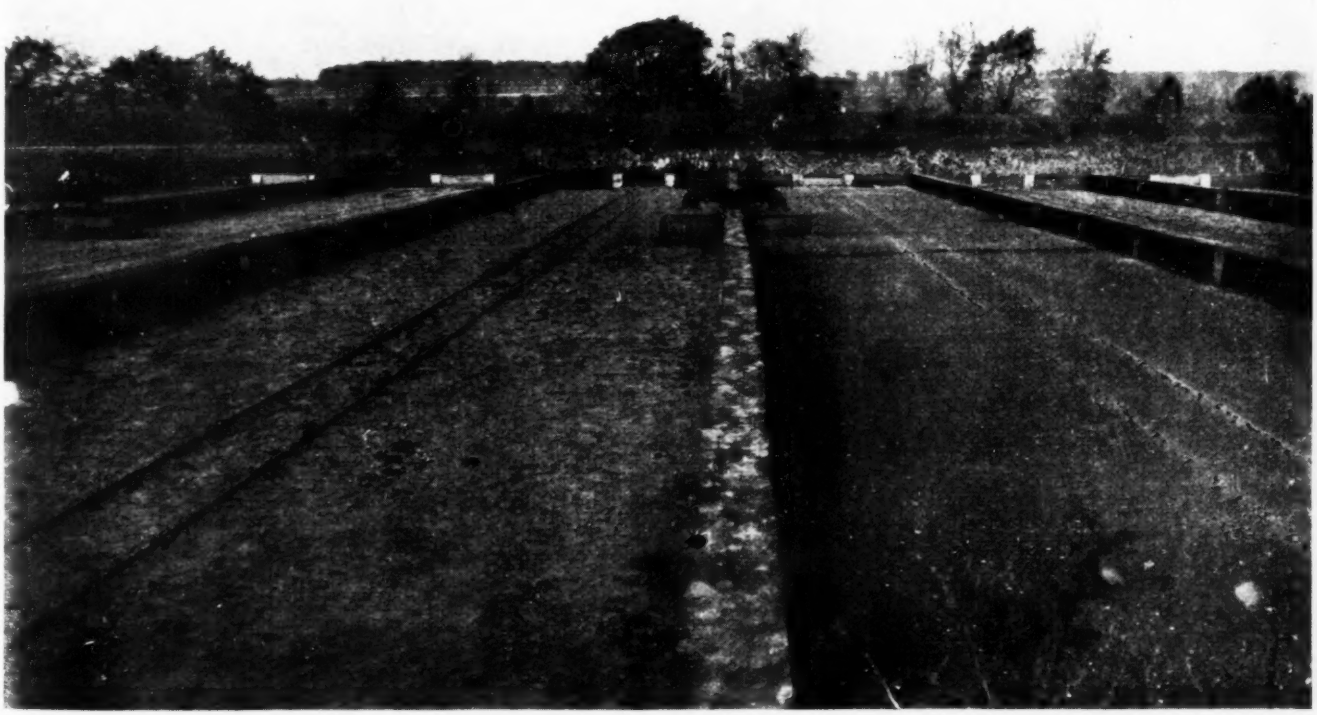
Sanitary Engineer, Department of Public Works Schenectady, N. Y.

IN THE good old days before municipalities built huge piles of concrete and reinforcing rods and labeled them "sewage-works"; in the good old days when "sewage" was not a parlor word, the little old country schoolhouse gave the future presidents of the United States and of the Women Voters Leagues a training in the three r's before they were rushed out into the world to meet their fates. Today, the treatment works is giving sludge fully as complete a finishing in the four d's before sending this material out into the world to meet its fate.

If it weren't for these four d's of sludge, the sewage works superintendent would have plenty of time to sit with his feet cocked up on his desk and puff away at a big fat cigar. These essentials of good sludge practice are *Deposition, Digestion, Drying* and *Disposal.* From the moment that the sewage glides from the cool stretches of the trunk sewer line into the vastness of the settling tanks, the solids are given the euphonic name of "sludge" and the cycle of circumstances starts. The portion of 1 per cent of solids that are carried along by the community's used water is but an infinitesimal fraction; it soon becomes an improper fraction to the plant operator.

About the time that mastery of the three r's was the acme of academic perfection, there must have existed a species of sewage-works operated by a species of technician who figured that running the plant could be a side line to owning the town barber shop. Why worry about the plant? The deposition of solids must go on if the unseen power of gravity that Newton discovered many years ago and presented to the sanitary engineering profession, continued to function. All the operator had to do was to sit back and let the pearly waters drop their load during the sojourn in the tanks. And as for digestion, that was fully as simple. The mass of natural bacteria chewed over the material and, presto, the green solids were converted into beautiful, gas-filled, black, tarry-odored sludge that just cried to be taken out of the tanks into the summer sunlight. Drying was certainly no trouble. Between the rush of shave or haircut customers, the operator could run down and open the gate that emptied the sludge into a sand bed. The good old summer time lent assistance with its sun and drying breezes and the same boys who cleaned the streets, unplugged the sewers and cared for the water plant, could be sent down on an off day to throw the cake off the sand into the tall grass around the beds.

But this was all before the days of big plants and operators who were technically trained enough to discover that all of these processes were not automatic. This was all before the days of temperamental solids that failed to deposit in the proper place, before the days when sludge discovered that it had an optimum pH and should insist on being associated with just the proper amounts of green solids, before the days when the drying of sludge became a process involving the operation of acres



Sludge Drying Beds at Schenectady, N. Y.

of beds, glass-covered drying solariums, a complete railroad system and crews of men. How can an operator rest easily in the face of the sludge problem of the modern plant?

It can be said, that many of the problems of sludge handling have been solved. Better design has resulted in improved conditions of deposition. An array of mechanical equipment has been adapted to the sedimentation tasks of the modern sewage works. Coarse and fine screens, detritors and skimming tanks have been built up around the tanks like so many satellites of an astronomical constellation. Sludge digestion has felt the impress of liming. Heat has been supplied to make the poor bacteria work overtime. Now, super-heat steps into the sludge field with a new set of bacteria. There used to be a time when sludge agitated the plant operator. Now sludge is being mechanically agitated by a nonchalant operator. Sludge is being given the most loving care. After a period of controlled, intensified digestion the material is being evacuated from the tanks by the gentle lift of air, by the compelling suction of pumps and by the Newtonian urge of gravity. It is being conducted to covered beds, to presses, to centrifuges, to vacuum filters and to the cherry glow of rotary driers.

Despite the fact that the plant operator has learned

Active Propaganda Induced These Farmers to Haul Sludge

that he can grace a swamp or borrow-pit at his plant with the name of "lagoon" and can pump untold yards of sludge to the area, most of the sludge being produced finds its way into forms that require disposal. It is not enough that the sewage-works man understands the principles of hydraulics, of chemistry, of bacteriology and mechanics. He must assume the cloak of the suave salesman if he is to satisfactorily practice the 4 d's of sludge. The producer of sewage loses contact with it when the waste water gurgles down the drain; it is desired. It is significant that sludge fertilizer is today bringing the sewage-works back into contact with the sewage producer. The farm, the back-yard, garden, the lawn and the golf green are today feeling the caress of sludge. Sludge is being applied to land in the wet state, in semi-dry form and as a commercially-dried product. The material being produced in activated sludge plants, which look more like huge factories than like orthodox plants, has been given high-sounding names and is out in the fertilizer field doing battle with high-powered plant foods.

There may be some sections of the country, so blessed, that the farmers will appear at the sewage-works without urging on the part of the municipal officials, but these locations are all too few. In other places, it will require active effort to convince the farmer that he should drive down to the treatment works, load up with a mass of black, mucky looking sludge and drive away with creaking springs to his own land. There will be much dubious shaking of heads and shrugging of shoulders before the produce growers are convinced. The works operator may have to talk like a diplomat, over-emphasize like a trooper, harangue like a peddler and discourse like a soil technologist before he can get a few men to try sludge. Such effort will be rewarded. When the farmers drive down with their trucks some day, back up to the piles of sludge in the field, peel off their jackets and bit

These Fellows Will Drive Away With Creaking Springs

into the accumulation with scoop shovels and forks, the salesman can expand his chest and say to himself, "Well done, brother."

There may be much satisfaction in getting good sedimentation efficiency out of tanks, making the pH of the sludge jump through the hoop every time the whip snaps and watching the wet sludge pour out of the sludge gate at just the right color and consistency. There is fully as much satisfaction to be derived from watching the products of these labors pass up the roadway leading to the city street in the varied-sized and varied-hued trucks of the customers.

Salesmanship Will Sell Many Beds of Sludge Like This

There is a right way and a wrong way to attempt to create a market. The farmer is a wary gentleman and will not believe any rose-hued statements that are made in advertisements. The present move of farmers toward co-operative efforts gives the marketing clue to the sludge salesman. The many associations of farmers or market gardeners are headed by trained technologists. These are the

men to interest in sludge. If they can be "sold" the battle is half won. They can do much to get the first few hardy spirits to venture down to the plant. When they drive home with their queer-looking loads their neighbors will want to know all about it. If the sludge-user has a better crop that year, the market is made. If not—but why go into that?

Don't expect the farmer to enthuse about sludge. I spent several years trying to get a few of the most important men in the section to say sludge was a good fertilizer. The best recommendation I could get from one was that it helped keep the sand from blowing. It just so happens that this same fellow came down one fall and found the sludge all gone after an unprecedented early sale. He felt that he had been treated poorly and I attempted to soothe his feelings by telling him that the worst that could happen was that his sandy land would blow. I did get a compliment for sludge from a brusque old fellow who attended a meeting I addressed. We were talking about the value of sludge on land in a certain section, when I turned to this farmer and asked him to tell the folks why he had been drawing it for the past two years. This impromptu press agent growled, "Men, that stuff is no good at all, but if you want to you can haul all it out here and dump it on my land."

There's humor in this business of sludge selling. We started to sell our sludge for ten cents a load, the price being set as a compromise from the decision to give it away for the first year. It took an official receipt book, making four colored copies and costing about ten dollars, to record the sale of about eight dollars worth of sludge. It took all the time of one of the plant laborers to keep track of the thin dimes taken in and to check off the fat loads taken away. Before the price was raised to twenty-five cents a load, the opinion of several farmers was sought. To a man, they predicted the loss of all customers by such high-handed manipulation of prices. It even became evident that the farmers feared to admit the merits of sludge because of a possible rise in price. Despite the cheapness, many farmers loaded their trucks so heavily that they had trouble making the grade up the road from the plant. Despite these difficulties, I admire the producer as a fellow who knows what he wants and why he wants it. That he will not open his innermost thought to any searching glance is but natural. He is ever hoping that he will have a bumper crop in the face of a poor year. Only through such a coincidence can he profit most.

Returning to the soil what comes from it may be one of the methods of farm relief. Returning sludge to the soil that raised the materials from which sludge is formed is certainly one of the methods of sewage-works relief. The production of a market is a difficult task and will keep the feet of the superintendent off that desk we were talking about. If an operator is satisfied to lagoon sludge or to allow it to accumulate about the plant site, he is not giving the material the finishing afforded by the four d's. The job is not completed until sludge has been *deposited, digested, dried* and *disposed*.

KEYSTONE EXCAVATOR ON ROCHESTER, N. Y., JOB.—In an article in our February issue—"Methods and Cost of Constructing Corrugated Iron Pipe Sewers"—it was stated that the trenching was done by a Bay City excavator. This was a mistake, as the machine used on this work was a Keystone Model 4 front crawler gas drive excavator, with the Keystone patent pullscoop ditching bucket.

March Meeting of New York State Sewage Works Association

The Third Annual Meeting of the New York State Sewage Works Association was held in Albany, N. Y., March 5, 1931. Eighty members and guests were registered. At the business meeting Messrs. W. P. Gyatt (Syracuse), C. A. Howell (Buffalo), and E. B. Phelps (New York) were elected to the Executive Committee in place of Messrs. H. B. Cleveland, M. Cohn and G. D. Holmes, whose terms of office expired. John F. Skinner of Rochester was elected president, and Professor E. B. Phelps of New York City, vice-president. A. S. Bedell, State Department of Health, Albany, was reappointed secretary-treasurer.

At the morning session Lawrence Luther gave a paper describing construction and operation of the sewerage system and sewage treatment works at Freeport, Long Island.

At the luncheon Dr. Huntington Williams, secretary of the State Department of Health, welcomed the group on behalf of Dr. Parran, the state commissioner of health, and assured them of the latter's interest in the activities of the association. W. J. Orchard, as usual, supplemented his delightful humor with a serious appeal to make use of civic pride to obtain sanitary improvements through some system of scoring health standards.

The afternoon was devoted to a symposium on sludge. E. F. O'Brien of Syracuse, N. Y., opening the discussion on "Collection and Digestion," followed by a prepared discussion by W. B. Corwin, Larchmont, N. Y. W. A. Ryan, Rochester, N. Y., presented a paper on "Drying and Disposal," which was followed by a prepared discussion by Morris Cohn, Schenectady, N. Y., and G. E. Willcomb, Albany, N. Y. Both subjects were fully discussed from the floor.

Water Tower of Reinforced-Steelwork Construction

A 350-000-gal. water tower at Harpenden, Herts, England, is described as being of "reinforced-steelwork" construction. The frame of the tower is of rigid steel construction, consisting of both rolled sections and plain round rods, the rods being secured to the structural sections by means of specially-shaped stirrups which surround the bars and pass through the metal of the rolled sections. The structure is completed by pouring concrete about this steel skeleton framing. The steelwork is designed to carry the dead load of the forms and the wet concrete, as well as other loads incidental to construction.

In this type of construction, following the erection of the steel frame, the forms are attached to and suspended from the skeleton, thus eliminating shores and scaffolding of all types that might otherwise be required. The forms may be stripped as soon as the concrete has attained enough of a set to adhere to the steel frame work. Certain advantages are claimed for this system—among them, speed of construction and the assurance of accuracy in the location of the steel.

The tank of the Harpenden water tower has an internal diameter of 65 ft. 10 in. and a depth of water of 16 ft. 9 in. The tank is supported by 30 columns braced by four tiers of horizontal struts. The height of the tower, from foundations to tank roof, is 102 ft. The structure stands on chalk foundations. The total period of construction, including work on the foundations, was 17 weeks.

Fundamental Principles of Well Construction

A Discussion of the Features of Well Construction Having to Do With the Problems of Safeguarding the Sanitary Quality of the Water Supplied

By A. G. FIEDLER

Hydraulic Engineer, U. S. Geological Survey, Minneapolis, Minn.

THE selection of a proper site for a well which is either to provide a new source of water supply or to augment an existing supply is a basic requirement that may eventually prove to be the controlling factor in securing a continued supply of satisfactory sanitary quality. The selection of a well site may be greatly limited by conditions over which the waterworks superintendent or the water-supply engineer has no control, and for this very reason special thought should be given to the limitations of the site selected before deciding upon the type of well construction and method of finishing that are to be used.

Selecting the Location.—A study of the geology of the locality, together with the information supplied by nearby wells, may furnish sufficient information upon which to make an intelligent decision in regard to the size of well, the probable capacity of the water-bearing strata, the mineral quality of the water, and the type of well necessary to develop the supply at the selected site to the best advantage. However, if any uncertainty exists in regard to these features or if there is a choice of several sites, each site should be thoroughly prospected by test drilling. In many localities so little information regarding the ground-water conditions is available that a suitable location which will yield the required quantity of water to a well must first be discovered by prospecting; otherwise only a dry hole may be obtained, or the yield of the completed well may prove to be so small that it would not be economical to utilize the well. Because of the great value of the information obtainable by properly drilled test holes, such preliminary investigation is more and more coming to be considered an essential part of ground-water development that involves an expenditure of any great amount.

Conditions Having Bearing on Sanitary Quality.—The principal features of the location that have a bearing upon the sanitary quality of the water to be obtained from a well are the nearness of existing sources of pollution, the location in reference to flooding, and the character, depth, and water-bearing properties of the formations to be tapped.

Distance is the simplest safeguard for preventing the contamination of a well water supply by existing sources of pollution, such as sanitary and storm sewers, cesspools, and privies. Even though a well may be properly constructed, the well casing and seals are subject to deterioration and the additional protection that is afforded by locating the well an adequate distance from sources of pollution should therefore always be secured wherever possible. No fixed distance can be stated as offering the required safety, for the different factors vary so widely that each location must be considered as a separate problem. Where relatively shallow unconsolidated deposits are utilized, cesspools and earth-pit privies are especially dangerous, and no well should be put down within a radius of 250 ft. from them. The same consideration holds in reference to a sewer, though if the sewer is known to be of good construction the distance of the well from it may be considerably less than 250 ft.

A location that is subject to flooding by surface or waste water is entirely unsuitable as a site for a well used for domestic supply. If no other satisfactory location is available, special care must be taken to bring the top of the well casing at least 2 ft. above the highest known water level for the locality. If this is not feasible, special flood protection works such as levees or embankments should be constructed around the pumping plant, as is being done at several places in the lower Mississippi Valley.

The character and depth of the water-bearing formations that are to be utilized not only control to a certain extent the original purity of the supply but also have a bearing upon the problem of maintaining the supply in a satisfactory sanitary condition. Shallow surface deposits such as are used in many places to furnish the supply for shallow open dug wells are very likely to be contaminated in a populous community, and hence they should not be generally utilized if other satisfactory locations or deeper sources of supply are available. Shallow limestone formations are especially undesirable, for even though the limestone may be covered by more impervious formations at the well site it may crop out in an area where considerable pollution occurs on the surface, and such contaminating material may be readily carried down to the water table through joints, solution channels, or sink holes and eventually reach the well. It has also been found that even water in limestone formations at considerable depths may be contaminated either from surface pollution entering through distant sink holes or from artificial openings such as have been used in some localities as a means of disposing of industrial wastes or other undesirable matter.

In general, fine-grained rock formations that furnish a definite filtering action to water passing through them are free from contamination if they lie at a sufficient depth. The denser rocks, such as limestone, granite, gneiss, or schist, which contain water chiefly in crevices, solution channels, or joints, are more likely to contain water of a questionable character, because little or no filtering action is afforded by such openings, and pollution may therefore be carried in them for great distances.

Types of Wells.—The drilling and construction of water wells is not a standardized procedure, for conditions vary so widely from place to place and the requirements imposed by different conditions likewise vary so widely that many types of wells and methods of drilling and finishing have been developed. Each type of well may be said to possess certain features of merit that adapt it to a particular set of conditions, and such a well, if properly constructed with a view toward meeting the special requirements involved, would yield water of a satisfactory sanitary quality. However, wells of certain types furnish much better protection to the purity of the supply than others, and hence such types of construction should always be utilized wherever possible.

Contamination may enter a well either from the surface or underground, and hence a well can not be regarded as properly constructed unless means are pro-

vided to exclude effectually pollution from both these sources. The methods of properly finishing a well at the surface are relatively simple in application and are essentially the same for most types of wells, regardless of the system of drilling that is used. To prevent underground contamination, special methods of finishing have been developed which are very effective when used in conjunction with modern drilling practices, and such methods are gradually being adopted wherever the best type of construction is desired.

Protection of the Well at the Surface.—In general, most contamination at the surface enters the well through the well opening proper, and hence it is important that the space between the casing and the pump pipe should be tightly sealed by means of an approved sanitary well seal or a suitable bushing and packing gland. Utter disregard of this elementary principle of satisfactory well construction has been noted in innumerable wells scattered throughout the country, and it is largely the reason why many wells yield water of unsatisfactory sanitary quality. For an open dug well a water-tight cover, preferably of impervious concrete, should be used. Covers made of wood are subject to more or less rapid deterioration, and because of constant warping and shrinking they can not readily be kept water-tight. Good construction also dictates that the casing of a drilled well should extend at least a foot above the general level of the surrounding ground or above the level of the pump pit floor if a pit is used. Incidentally it should be said that pump pits or under-ground construction are quite properly regarded with disfavor by state boards of health, and in water and drainage away from rather than toward the some states such construction is prohibited for wells used for municipal supplies or those used by the general public.

Another place at which pollution from the surface can enter a well is around the outside of the casing or curbing. The space between the outside of the curbing or casing and the wall of the hole should therefore be securely sealed at the surface to prevent the downward percolation of undesirable surface water or waste. This can be accomplished by thoroughly puddling the space around the casing with clay and sealing the upper 5 ft. with concrete. A concrete platform should then be constructed around the well, and the upper surface of the platform should be sloped so as to conduct all surface well. It should be mentioned, however, that unless the well is protected by a heated pump house, the concrete platform around the well should not be tightly bound to the well casing, for the alternate freezing and thawing of the ground may produce severe stresses on the casing and displace it. Where a pump house is built around the well it is also very important that the pump house floor should slope away from the well so that grease, oil, and other impurities will not accumulate around the well casing. In view of the wide use of turbine pumps in wells of large capacity this requirement can be most satisfactorily met by mounting the pump upon a concrete block which extends at least 1 ft. above the floor level. If this type of construction is not used, a water-tight seal at least 6 in. deep of either asphalt or lead should be provided between the casing and the pump house floor.

In areas where the water is contained in fine sand that it not readily separated from the water by the usual well screen and development methods, the gravel wall or gravel packed well has been used. Such a well may be constructed by several methods. A preferred method is to sink a large outer casing to the water-bearing stratum and to place within this casing a smaller casing and well screen that penetrates the water-bearing formation. While the well is being developed to remove the fine sand and silt the space between the two casings is filled to an adequate depth with screened gravel. In order to save expense the outer casing is sometimes removed for use elsewhere, but this is a very unwise policy, for the space between the well casing that is left in place and the sides of the hole is difficult to seal satisfactorily. Furthermore, if the well must be repaired or redeveloped at some later time, the repairs will be more complicated and less readily made if the outer casing has been removed. For the best type of construction the outer casing is not only left as part of the completed well, but it in turn is securely sealed in place by puddled clay and concrete according to the method above described.

Protection of Wells from Underground Contamination.—It is quite evident that the purity of the water supplied by a well is dependent upon the quality of the water at the source. Hence the problem of protecting the well from underground pollution is largely one of maintaining the original purity of the supply by excluding both water of questionable sanitary quality and highly mineralized water, which is unsuitable for use.

Underground contamination may enter the well chiefly because of defects in the casing or curbing. The major defects of this sort may be classified in four general groups—insufficient casing, defective casing, improperly seated casing, and defective sealing between casings where the diameter of the well has been reduced.

Very shallow ground water is generally subject to contamination, and it is therefore especially essential that sufficient casing or curbing be used to exclude this water effectually. Because of the seasonal fluctuations of the water table, the casing or curbing of a shallow well should extend some distance below the lowest level reached by the water table when the well is pumped during the season in which the water table is normally at its lowest point. This is necessary because it is within the range of the fluctuation of the water table that the greatest amount of contamination appears to be concentrated. In the best construction a deep well should preferably be cased to the water-bearing stratum that is utilized, though under certain conditions the casing may be seated securely in an impervious formation above the water-bearing stratum.

Each well should be considered as a distinct problem and the casing and method of protection that has proved most successful under like conditions in other areas should generally be used. The same condition applies to the selection of material for the well screen in a well that obtains its supply from unconsolidated formations. Though a screen performs a vital function in the successful operation of a well, it generally represents only a very small percentage of the total cost of a well project, and the water-supply engineer is extremely short-sighted if he endeavors to economize on it.

It is obvious that even though a casing may be of the best material and of sufficient length it will not exclude contamination unless it is properly seated. The usual faults in seating the casing are wedging the casing off the bottom, seating in a creviced or soft formation that is subject to spalling or caving or in a formation that is not impervious, or seating the casing without a shoe. The remedy for each of these faults is apparent, and they can all be avoided by competent drillers who use good equipment.

In some localities difficulty is experienced in seating the casing securely in a relatively hard and impervious

formation, and packers are used to seal the bottom of the casing to the wall of the hole. In drilling by the hydraulic rotary method heavy mud-laden fluid is circulated behind the casing and serves a beneficial purpose in preventing the access of water to the casing and delaying deterioration due to the action of corrosive water. If these general methods are not satisfactory the casing is securely cemented at the bottom or the entire length of casing is cemented in the hole. Practically all the methods of cementing have been developed in the drilling of oil wells, where water problems are frequent, although none of them are more important than that encountered in water wells of protecting the purity of water used for domestic supply. The additional cost of applying these special methods of finishing usually represents only a small percentage of the total cost of the average public water-supply development and is generally warranted in view of the many benefits to be derived. Proper seating and sealing of the casing is especially important where artesian pressure is encountered, for it is evident that if the seal is not water-tight, considerable water may be wasted underground and the static head of the water will be lowered accordingly.

The entrance of surface pollution between casings where the well has been reduced in diameter is probably not very common, as usually the well is drilled to a considerable depth before a reduction is necessary. However, highly mineralized waters, which are detrimental to the supply, may enter at such points unless the space between the casings is effectually sealed. Proper construction requires that the lines of casing overlap each other by at least one joint and that a suitable seal of lead or similar material be used to close the space between them. Cement can also be used to advantage under some conditions, or the inner casing may be extended to the surface in order to insure absolute protection.

Chlorination of Completed Wells.—Within recent years attention has been given to the subject of chlorinating new wells, and this procedure may be regarded as an essential part of good construction, particularly where the well is intended as a source of supply for a municipality. During the course of construction considerable contamination may be introduced into the well on the drilling tools or the well casing or by using gravel from sources that are badly polluted. Contamination on the tools is not easily avoided, but gravel can be readily freed from contamination by washing with chlorine solution.

A well may be chlorinated under pressure or by simply introducing a strong solution of chloride of lime into the well with a dump bailer. The former procedure is probably the more effective, but it requires special pumping equipment, which is not usually available with cable tool drilling machines. Under most conditions chlorination by introducing the solution with a dump bailer is adequate, but if contamination still exists after a thorough pumping following the dosing of a well in this manner chlorination under pressure may then be desirable, provided the hydrostatic head is not excessive.

Summary and Conclusions.—It is difficult two evaluate the respective importance of those features of proper well construction which act as safeguards in maintaining the sanitary quality of the water. As a matter of fact, each feature serves a very definite purpose in excluding contamination from the well at certain places.

Within recent years the water well construction industry has made great strides in developing new methods and using new materials in order to provide economical ground-water supplies that will satisfy the highest standards of sanitary quality. Even the best type of well construction, however, does not release the waterworks superintendent from the responsibility of maintaining a constant vigilance over the purity of the supply. If contamination is found to exist at any time prompt steps should be taken to locate and remedy the trouble and if the difficulty can not be overcome proper sterilization should be provided as with surface-water supplies.

Acknowledgment.—The above is an abstract of a paper presented Feb. 13 before the meeting of the Ninth Annual Waterworks School, Lawrence, Kans. It is published with the permission of the Director, United States Geological Survey.

Safety in Trench Construction

Trench construction is a hazardous operation, and one in which the workman has little chance to escape should an accident occur. The revised accident-prevention manual of the Associated General Contractors of America observes that particular attention should be given to shoring, and gives the following rules for work of this nature:

Keep workmen separated to avoid being struck by neighboring workmen's tools.

All lumber used for sheeting and sheet piling should be sound and straight and of adequate dimensions throughout.

Whenever running material is encountered, the sides of all trenches should be secured by the use of sheet piling. Such piling should be adequately braced.

In trenches between 4 and 7 ft. in depth, wooden sheet piling should not be less than 2 in. thick; over 7 ft. in depth, not less than 3 in. thick.

In hard, compact ground (soils other than running, saturated, filled or unstable material) 4 ft. or more in depth, the sides of the trench should be shored and braced at proper intervals with 2x6-in. planks or heavier, placed vertically in the trench, opposite each other, against the walls. These braces should, if possible, extend to the bottom of the trench.

The bracing and shoring of trenches should be carried along with the excavation and should in no case be omitted, except where a mechanical trencher is used. In this case the shoring should be placed as close up to the lower end of the boom as possible.

The braces should be supported by screw-jacks or by timbers placed at right angles to both braces, cleated and rigidly screwed or wedged.

Trenches in saturated, filled or unstable material (not running material) should be sheeted to an extent adequate to hold the material in place. The sheeting should be supported adequately, either with screw-jacks or timbers or both.

The excavated material should not be placed nearer than 18 in. to the edge of the trench.

NEW OFFICERS FOR AMERICAN WATER WORKS ASSOCIATION.—The nominating committee of the American Water Works Association has selected the following nominees for the offices to be filled at the Pittsburgh Convention for 1931-32:

For president: Ross L. Dobbin, superintendent of water works, 223 Aylmer Street, Peterborough, Ontario, Canada; for treasurer, William W. Brush, chief engineer, department of water supply, gas and electricity, Municipal Building, New York, N. Y.

Operation of New York's Water Supply System

An Outline of the More Common Problems And How They Are Handled in Connection With Operating the Water Works of the Largest City in the United States

By WILLIAM W. BRUSH

Chief Engineer of Water Supply, Department of Water Supply, Gas and Electricity, New York City

IT IS the writer's intention to set forth as briefly as he can the New York City water supply's practice as to certain items, not with the idea that the New York City practice is the most desirable, but rather to promote thought on and discussion of such items.

WATERSHEDS.

Purchase of Land for Protection of the Water Supply from Pollution.—Since chlorination has been available for sterilization of water it has not been considered necessary to purchase land beyond a marginal strip about 500 to 1,000 ft. wide around each reservoir. Unless one can control the entire watershed, there appears to be little advantage in securing control over even the land bordering the streams. There is a decided question as to the wisdom of making large areas uninhabitable when such areas are part of a watershed and when the areas might be kept available for habitations and at the same time the wholesomeness of the water supply be amply protected.

Patrol of Watersheds.—It is only good housekeeping in water supply to keep the area from which the water is secured in as clean a condition as may be practicable. The desirable frequency of inspection depends upon the character of occupancy. The intelligence and diplomacy shown by the inspector is usually more important than the number of times he may visit any location. At present our trend is towards fewer inspectors and providing automobiles for more of the inspectors. The inspectors are also used to prevent as far as possible unlawful entry on the water supply property, bathing in the reservoirs and the commitment of nuisances. The number of watershed inspectors and assignments are as follows:

Watershed	*Area in square miles*	*Number of inspectors*	*No. of automobiles for inspectors*
Schocharie	314	3	3
Esopus	257	5	none
Croton	375	15	7
Bronx and Byram including Kensico Reservoir	22	5	1

Bathing, Boating, Fishing and Ice Cutting.—The New York State Department of Health does not prohibit bathing in waters from which public supplies are taken and looks to the community using the water to adequately purify it. Bathing is of course prohibited when the city owns the shore of the stream or reservoir. Bathing, however, takes place in several bodies of water tributary to the city supply and at some locations public bath houses are established. In the writer's opinion it is probably not unreasonable for the state to allow persons residing on a body of water to bathe therein even if the water later flows into a water supply reservoir, but the development of such bathing as a business should be prohibited.

Boating, fishing and ice cutting are, by law, allowed on the city reservoirs under regulations established by the department. A department permit is required to keep a boat or cut ice on a city reservoir, but no permit is necessary to enter water supply lands for fishing from the shore or from a boat for which a permit has been issued. No renting of boats is allowed.

Sewage Collection and Disposal.—When the development of a community reaches the point where a public sewer system is desirable to protect the water supply under the law, the city in agreement with the local officials builds and operates the sewer system, extending the house laterals to the buildings and the owner at his expense must make the connection. Individual residents and institutions must provide for sewage disposal in a manner satisfactory to and under plans approved by the department and for the larger plants the State Department of Health must also give its approval.

Chlorination of Stream Flow.—Where tributary streams are sufficiently polluted by bathing or by density or character of resident population, the department installs a chlorinating plant which will treat all but the flood flows and thus nullifies the greater part of the polluting material and bacteria. These small plants are visited by an employee once a day or at a longer time interval and therefore cost very little for operation. It should be kept in mind that all the water thus treated is later again chlorinated at least once and usually twice before being delivered to the consumer.

Taxes.—On water supply lands and structures other than aqueducts located outside of the city limits, the city pays taxes amounting to over $1,000,000 annually. Naturally the views of the local tax assessors and those of the city's representatives do not agree as to the assessments and it has therefore been necessary to generally protest and frequently litigate such assessments.

Reforesting.—The state furnishes free pine seedlings for reforesting and some 30,000 to 40,000 of these seedlings are annually planted on water supply lands. To date about 6,000 acres have been covered, representing about one-quarter of the city's holdings of land above flow lines.

Copper Sulphate Treatment.—The microscopic growths are controlled by copper sulphate, which is generally applied when and as required by using launches and boats with outboard motors. In the late fall a special examination is made of the water in the reservoirs which feed directly into the aqueducts to determine if the growths are such as to require a treatment as a precautionary measure before the ice forms. In a reservoir like Kensico it is usual practice to make a treatment in December of each year. In the Croton system where the water must be drawn only from one body of water, Croton Lake, a plant has just been installed so that copper sulphate solution can be pumped into the water on the upstream side of a small dam. An 8-in. wooden pipe with small copper tube outlets is being used. This plant has not been in use long enough to demonstrate its efficiency.

Weed Growth on Exposed Areas.—As the various reservoirs are drawn down a rapid growth of vegetation takes place on the exposed areas. Many years ago effort was made to burn or otherwise destroy this growth before the area was again flooded but without much success. No detrimental effect on the quality of the water has been noted due to the water later flooding over this exposed area.

Aqueducts.

Cleaning of Interior.—Virtually no interior cleaning is done of the aqueducts. The siphon forming that part of the Croton aqueduct which is under the Harlem river has not been cleaned for 30 years. Chlorination of the water helps to first remove and later prevent growths forming on the sides and bottom of the aqueducts.

Patrol.—It is general practice to patrol the various aqueducts about once a month, although certain sections are examined more frequently.

Stopping Leaks.—Fortunately there are a few leaks on the aqueducts except on the old Croton aqueduct. This latter aqueduct is structurally weak as the side walls are not sufficiently massive to withstand the overturning force of the water without the support of the earth backing. For a small leak the introduction of a mixture of cement and sawdust into the water flowing through the aqueduct will usually be effective. When it is necessary to close up a crack by emptying the aqueduct, the use of lead wire about ⅛ in. in diameter caulked into the crack has been found effective.

Crossing by Other Structures.—Where it is necessary to have a sewer or water pipe cross an aqueduct, special attention is given to the design to make certain that the pipe crossing the aqueduct is adequately supported so as to minimize likelihood of breakage and for sewer crossings cast iron pipe with lead joints encased in a concrete envelope or steel pipe is required for the full width of the right of way. A charge of $10 per annum for each pipe crossing is made.

Aerators.—At Ashokan reservoir and also at Kensico reservoir outlet there is an aerator each with about 1,600 nozzles. At Ashokan all the water amounting to 600 million gallons daily is passed through the aerator while at Kensico about two-thirds is aerated, this amount being the capacity of the aerator. The Kensico aerator operates throughout the year, while the Ashokan aerator is shut down between Dec. 1st and the following April to prevent ice formation. The aerators are a beautiful part of the Catskill system and break up some of the more fragile organisms, but are not essential for satisfactory operation.

Chlorination.—All water delivered to the consumer is chlorinated at least once except certain well supplies where the conditions and past history of the supply makes chlorination appear unnecessary. The usual rate of application is about 2 to 3 lb. per million gallons, although at some points it is as low as ½ lb. and at times as high as nearly 6 lb. Generally the rate of application is such as to maintain one-tenth of a part per million of free chlorine. With a well water a lower content of free chlorine is usually necessary to avoid chlorine odor or taste. There is no odor or taste of chlorine in the water supply except under unusual circumstances. A higher rate of chlorine application is made when microscopic organisms are sufficient in number to cause a taste in the water so that such taste as well as the organism is destroyed by chlorine.

Double chlorination of all surface supplies is a practice which the writer thinks is most desirable as a safeguard for the consumer. With chlorine costing in ton containers about 1.7 ct. per pound plus freight and handling charges at destination, the cost of double chlorination is almost negligible. The provision of spare chlorination equipment at every plant, so that machines will be available to replace any in need of repairs, is considered essential for safety.

Distribution.

Reservoirs.—All distribution reservoirs are gradually being enclosed by wire link fence of the so-called non-climbable type from 6 to 7 ft. high, but without barbed wire on the top. The omission of the barbed wire is due largely to the objectionable appearance of this wire. There have been two suicides in reservoirs so protected, the period covered being about four years and previous to erecting the high fence in one reservoir there were one or more suicides each year.

The sea gulls flock from the polluted waters of the bay and rivers to the reservoirs from August until the following April. Permit to kill the gulls has been obtained from the U. S. Government for two of the reservoirs and some success has been secured in driving the gulls away.

On the mains that connect gate houses with the distribution system and where there are several parallel mains, the valves are equipped with electric motors and float indicators show the main upon which a break may occur.

Consideration should be given as to the possibility of making either daily or emergency use of a higher level reservoir for a lower level service. The practice of using an intermediate service reservoir in Brooklyn to reduce the draft on the Catskill aqueduct tunnel for the low service has been adopted for the past two years with very satisfactory results. This reservoir, which is known as Mt. Prospect, has a flow line at elevation 202 ft., a depth of 20 ft. and a capacity of 20 million gallons. It is filled by water from the Catskill system and this system also supplies a large portion of the low service with a hydraulic gradient of about 150 ft. By delivering water from Mt. Prospect reservoir into the low service during the morning and afternoon periods of high draft at the rate of from 30 to 40 million gallons daily, the Catskill tunnel gradient in Brooklyn is maintained about 10 ft. higher than would otherwise be the case and expensive pumping for the high service supplied by the Catskill system has been avoided. About two-thirds of the reservoir contents are discharged during the daylight hours and the reservoir refills during the night hours.

Distribution Mains.

New Mains Installed by Use of Corporate Stock Funds.—When an extension to the distribution system is requested, if there will be one house for each 150 ft. of main with an allowance of an additional 100 ft. of main for each extra family in a house, the extension of the main is usually authorized and the cost is met by the sale of corporate stock, the property owner making no direct payment for the installation of the main.

To accelerate the extension of mains and thus meet the needs of builders, the department purchases and stores in its yards the necessary 6-in., 8-in. and 12-in. pipe with the appropriate fittings, valves and hydrants and contracts under public letting for the laying of such pipe. All purchases are on the basis of department standards, the same standard for hydrants having been used for about 25 years and the valves for a somewhat shorter period. Corporation stops or taps are purchased by contract and inserted in the mains by department tappers at a fixed price to the property owner for each size of tap,

starting with 5/8-in. size. The minimum service size is 3/4-in. and the services are put in for and at the expense of the owner by a licensed plumber.

For the past year the cast iron pipe have been lined with cement coated over with coal tar or asphalt applied hot. It is expected that this year a cold asphalt coating will be applied. This covering of the surface of the cement by a substance insoluble in water prevents hard water developing in long mains with slow flows and probably greatly increases the effective life of the cement lining in preventing corrosion.

Under the specifications for pipe that are to be used this year, the department permits Universal and McWane

Cast Iron Hemispherical Drain Base for Hydrant

type to compete, having previously included centrifugally cast pipes. It, however, requires all the pipe to have the same barrel thickness which is Class B-AWWA. The bids will be compared on the resultant price per laying foot the quotation to be the price per ton. Special castings or fittings are to be only bell and spigot type.

In laying water mains and also in effecting repairs, special attention is paid to sterilization of the mains with chlorine. Chloride of lime is used for the smaller mains, a suitable amount being placed either in each length or else on the downstream side of the valve through which the water would pass in filling the main. For larger mains liquid chlorine is frequently used. As far as possible the laboratory reports on the sanitary condition of the water in new mains before they are placed in service. Where mains are to be placed in built up sections each length is to be washed out and swabbed with a chlorine solution before being laid.

Setting Hydrants.—In setting hydrants it has been the practice in rock trenches and clay soils to connect the hydrant drain to the sewer, using a lead lined iron pipe. When the soil would absorb the water, a blind stone drain was placed either under the hydrant or alongside the hydrant. Difficulty has been experienced in making certain that contractors placed the broken stone for the drains and also the department men would sometimes slight this work. A hemispherical cast iron dome, holding two and one-half the barrel contents of the hydrant is now being used as a combined support and drain for the hydrant when it is not connected to the sewer. (See Illustration.)

In laying mains the department has for many years used only 6-in., 8-in., 12-in., 20-in., 36-in. and 48-in. valves. On intermediate sized pipes the next smaller sized valve is used, and on 48 in. mains, 36 in. valves are placed.

The maintenance and operation of the distribution system is based on repair companies, of which there are several in each borough. Each repair company has its own headquarters and the majority maintain emergency force during the two night watches. Gate operating trucks are assigned to each borough. In Manhattan and the Bronx, where rock filled streets make the location of leaks very difficult, there is a separate organization to locate hidden leaks on the water mains. There is also a special force assigned to the operation and lubrication of the large valves.

The fire hydrants are inspected by the firemen in the fall of the year and the hydrants reported out of order are repaired by the water department force. In Manhattan and the Bronx, special gangs, consisting of a machinist's helper, laborer and light truck, are constantly examining and repairing hydrants which are used very extensively by the street cleaning force.

Pumping.—The only item of general interest in the pumping practice is the definite trend towards the substitution of electric power for steam on the basis that the cost is about the same and the electric drive is considered more satisfactory in built up sections than the steam power.

High Pressure Fire Service.—This service is operated by the Water Department, the pumps being started on the alarm being received and the pressure held at 125 lb. in Brooklyn and 150 lb. in Manhattan until a higher pressure is requested by telephone message from the fire department. The running of the stations is based on orders received from the fire department as long as the service is needed.

Acknowledgment.—The foregoing is an abstract of a paper presented Feb. 11 before the New England Water Works Association.

CONFERENCE OF MARYLAND-DELAWARE ASSOCIATION.—The Fifth Annual Conference of the Maryland-Delaware Water and Sewerage Association which is to be held at the DuPont-Biltmore Hotel, Wilmington, Del., May 5 and 6. A. W. Blohm, 2411 North Charles St., Baltimore, Md., is secretary.

PENNSYLVANIA WATER WORKS OPERATORS MEET IN JUNE.—The 1931 meeting of the Pennsylvania Water Works Operators' Association will be held June 25 and 26 at State College. I. M. Glace, 506 South Office Bldg., State Capitol, Harrisburg, Pa., is secretary.

The Water Works Superintendent and His Job

The Superintendent Is Not Only Concerned With the Adequacy and Safety of the Public Water Supply But Also With Stimulating the Intelligent Support of the Consumers

By W. SCOTT JOHNSON

Chief Public Health Engineer, Missouri State Board of Health

FIRST, consider the superintendent's job from the standpoint of the production and financial responsibilities. Never before has the public been so exacting with regard to what might be termed the aesthetic qualities of a water supply. By that is meant a water free from taste, odor, color, turbidity, and hardness. The demand for improved quality in practically every known commodity has not made an exception of water.

Travel from city to city has become so common that the public is well qualified by experience to judge what constitutes water of good quality. If there is any question regarding this, just allow the water from your plant to carry a slight overdose of chlorine for a day and then keep a record of the complaints. Even a clear, tasteless, and colorless city water supply, if hard, is deficient in meeting the growing desire for a reasonably soft water, that is so superior for most purposes.

Similar is the demand for a constant, undiminished supply for fire protection as well as for convenience. Within the time of our memory the public was fairly well satisfied with almost any kind of water and, in many cases, that for only part of the day. Those days are gone forever, and the water works superintendent today must not only produce a water of excellent aesthetic quality, but must supply it to the home faucet at a good pressure day and night.

Again, the last ten years have witnessed the expenditure of millions of dollars in the construction of new and improved water works systems in this country. More adequate purification and treatment plants housed in architecturally suitable buildings; larger, more extensive, and stronger water mains; vastly improved mechanical equipment; and greater storage capacities have been the trend in advancement. The maintenance and upkeep of the gigantic works, representing such a huge investment of capital, is a yearly increasing responsibility and an obligation of the superintendent to the public which has invested its money in such improvements.

Importance of Accurate Records.—Adequate maintenance of the water system demands, first and foremost, better and more accurate records and accounting systems. Without such records it is practically impossible to operate a water system economically. There is no way to determine whether the plant is making or losing money, no way to assure adequate reserves for depreciation and breakdown, and no basis upon which to plan for future expansion and development that constitutes real service to a community, unless accurate records are kept regularly. However, there are many water plants concerning which such fundamental records as amount of water pumped and number of connections, are not known.

Likewise, complete records of plant operation, particularly if water purification is involved, should be regularly and intelligently kept. Tests showing the chemical and bacteriological condition of the water, and the amount of chemicals used, including chlorine, should be matters of permanent record. However, there are many water purification plants where such an important and simple test as that for residual chlorine is made only every few days and no record kept of the results.

Superintendent's Responsibility for Health of the Community.—Last but not least comes the water plant superintendent's responsibility for the health of the community. During the last 10 to 15 years the courts and health officials have come to the sensible view that water-borne filth diseases are unnecessary, and it is only a matter of eternal vigilance, technical training, and unbending courage to enforce health rules and regulations, that are necessary to remove forever the guilt from public water supplies as a cause. If your city water system has any sanitary defects, these have undoubtedly been pointed out to you and the city council. The courts have uniformly held that after such warnings, or because of unwarranted negligence, the city or company is liable to the extent of damages for any filth-borne diseases contracted from drinking contaminated water resulting from such defects or negligence.

A city in New York state has recently paid the cost of negligence in safe-guarding its municipal water supply: the typhoid epidemic resulting from contaminated city water cost the city $350,000. For a small part of this amount the city could have prevented the epidemic, an enormous amount of suffering, and 22 deaths.

Likewise, inadequate sewage treatment or poor operation of a sewage treatment plant may result in the recovery of just damages from the city. The responsibility not only for protection of the public health, but saving the city from costly damage suits, rests squarely with the superintendent of these plants.

Some Things a Superintendent Must Know.—In brief, if the superintendent expects to make the most of his job he must know the biology, chemistry, and mechanics of supplying a water of excellent aesthetic quality; he must understand the engineering problems concerned with assuring a constant supply at all times; he must be qualified to maintain and keep in good condition a great variety of works constituting the integral parts of a water system; he must appreciate the necessity of records and their use; and lastly, he must have a complete knowledge of the safeguards and precautions that eliminate the possibility of contamination of the supply and the resulting danger to public health. These responsibilities exist just as surely for the superintendent of the small water plant as for the superintendent of the larger plant.

Only casual consideration of these facts indicates that no single individual in the average city has a responsibility as heavy or as important to the community's welfare as the water works superintendent. There is probably no one business concern that demands as complete or exhaustive an accounting system; there are few, if any, financial institutions which have as large a capital investment under one man's management, and certainly no single individual is as responsible for the health of the community as the water works superintendent.

Informing the Public.—So much for the superintendent's responsibilities relative to the safety and production

end. Let us consider the next most important factor in his job, namely, the public's or consumer's understanding of this modern business of supplying potable water. While the public has become more critical regarding the aesthetic quality of the water supply and the service rendered, there is unquestionably a complete and astounding lack of understanding relative to the actual technical difficulties and heavy responsibility which are a part of the superintendent's work.

Probably the public's lack of knowledge, if not misinformation, concerning the position of the water works superintendent in a community can, to a large extent, be explained by ideas conceived years ago, when a water system consisted of a steam pump on the bank of a creek, which represented an investment of only a fraction of the cost of an up-to-date plant and where the most exacting requirement for management was a moderately good fireman. Whatever may be the cause, the public and the city officials in too many cases still view the job of water works superintendent with insufficient understanding and appreciation to make the position what it rightly deserves to be in view of its responsibilities.

"Selling" the Water Works to the Public.—The idea seems to predominate that an inexhaustible supply of safe, sparkling water, available in the home at the turn of a faucet, is similar to the air we breathe—another gift that nature has bestowed upon mankind. The necessity and importance of a safe and adequate water supply and the technical qualifications needed to supervise and manage the operation of a water system are not news items that are brought to the attention of the citizens daily or more often, as is the case with many other commodities and services less essential.

In competition with other highly advertised commodities, is it any wonder that the municipal water system retains a very obscure place in the public mind and, consequently, receives slight consideration or thought? No attempt has been made to dramatize for the average citizen the difficulties and scientific study expended toward perfecting water purification practice. In other words, the salesmanship end has been sadly neglected. This, I believe, largely accounts for the indifferent attitute toward the superintendent's endeavors and the lack of consideration the utility receives.

It would be a conservative statement to say that the average water works superintendent receives considerably less remuneration than the average banker or doctor. The city officials themselves, amenable to the demands of their public, in most cases are no better informed, or have little more interest in, and knowledge or appreciation of, the water works superintendent's value. In most cases the superintendent of a privately owned water plant is an exception. His employers are usually men of wide experience in the water works field, who appreciate the value of an efficient superintendent and pay him accordingly.

If this is the existing condition, and, with notable exceptions, I believe it is, why is such an attitude allowed to exist and who is responsible?

The Human Engineering Side.—The average citizen knows practically nothing about the purpose, methods, and difficulties of water purification and supply. However, the technical man, concerned with the problem of devising the most efficient machine for performing a feat of vital importance to the safety of the public, becomes critical of the lack of support from the public to whom the entire plan is a mystery. A little more attention to the human engineering phase of the situation, the the enlistment of the coöperation of people as well as machinery, would produce the desired results.

I do not believe that, today, there is a single commodity, and water is no exception, which can be sold to the public simply because it is of excellent quality. The term "sold" is used not only in the sense of barter, but also to mean enlightening the public so that an understanding and appreciation of the worth exists, as well as simply a desire. That such an accomplishment is well within the realm of possibility, even regarding a commodity less essential than water, is evidenced by numerous examples.

The average citizen knows ten times more about the technique of the moving picture business than the water supply business—a credit to the publicity work of the moving picture business. However, familiarity in this case in no sense breeds contempt; to the contrary, it has developed the sale of this industry to the people. We are not only air-minded, but movie-minded. Would it not be possible to secure some place in the public attention and mind for the remarkable feats and skill necessary to produce a water supply?

Satisfactory Understanding Creates Support.—If the city officials and the public have failed to keep step with the greater responsibilities of the present day superin-

When a Stack is a Windmill

At the sewage disposal works of Larchmont, N. Y., two glass covered sludge beds with forced ventilation discharged through the stack shown at the left. As this is a residential community this stack was objectionable and the windmill shown at the right was built around it to disguise it.

tendent and the problems of water supply, it is largely because the superintendent has failed to realize the necessity of selling to his public this commodity. If the water works superintendent makes the most of his job, he must be concerned not only with the quality of the product and its proper distribution, but also the most important problem of salesmanship. Satisfactory understanding by the public concerning what their public water supply really is and means to them will create support, and even demand, for further improvements in the system and management. This should be as much the responsibility of the superintendent as any of the production problems. Today the water works system is one of the largest business concerns in the city, if not the largest, under one management. Water is the most indispensable and essential product for sale in the whole community which costs the citizen stockholders money to produce. It is only common sense to believe that a public which really has an appreciation of a superintendent's responsibility and the importance of an adequate water system will firmly support the utility.

It is becoming more essential daily that the public understand the vital importance of governmental agencies in protecting and controlling the health and welfare of every individual. Whether it is the health department, the water department, or the educational department, etc., its satisfactory and effective functioning under the pressure of modern civilization is essential and crucial to our welfare and very existence. Picture the catastrophe to health, business, and property in any of our cities if the water supply would fail for even so short a period as twenty-four hours. The loss, without exaggeration, would probably amount to thousands of dollars and possibly many lives. The water works superintendent's foresight and skill stand between the public and such an occurrence. The public not only should be acquainted with the vital importance of such governmental agencies, but it is an obligation of those in authority to spare no effort and plan to enlighten the uninformed and, therefore, unappreciative.

Support of Unofficial Organizations Valuable.—We have all witnessed, on repeated occasions, the effectiveness with which the public has been sold on the value of a particular face powder, tooth paste, cigarette, or automobile, and such improvements as a state highway system or hard surfaced roads, state parks, or a new jail. Is it unreasonable, then, to believe that a more complete and sympathetic understanding of its own city water system, the product of which is a daily necessity to life and health, would be lacking on the part of the public, provided its importance and value were thoroughly known?

Of course, it must be realized that, while the superintendent can do much in this direction alone, he must not fail to enlist the support of the numerous unofficial organizations in every community, which can be of material assistance. The efforts of such organizations in dealing with the public are always very effective and of great assistance. The solution of human engineering problems requires a no less adequate plan and sufficient time than other engineering problems. The methods and means of approach must be well conceived and the plan put into operation long before tangible results are expected.

However, if the superintendent is not vitally concerned with making his job what it should be, he may be sure no one else is, and it rests entirely in his hands to sell his services and commodity to the public at their true value. Failure in this respect constitutes his own loss as well as a loss to the public, which, unfortunately, at the present time is viewed by the latter with exasperating calmness. It is, perhaps, not too fanciful a prophecy that we may some day witness public opinion, of its own volition, demanding the very improvements which the superintendent recommended and should have successfully secured largely through his own efforts. Such a step will be a sad reflection on the water works profession, and might lead to unfortunate results.

The importance of effective salesmanship is undoubtedly appreciated by many superintendents. However, observations indicate that this number is entirely too small, and far too many are failing to realize the necessity of planning this phase of their work as carefully as the production end. Needless to say, adequate technical training, business sense, and sales ability are essential to developing an understanding by an enlightened public.

Selling a product is no longer possible without a thorough and complete knowledge of the commodity. Therefore, first and foremost, the water works superintendent, himself, must be thoroughly trained and informed regarding his work. Then he is in a satisfactory position to convince the public. Unfortunately, water supply and purification is perhaps not a subject that strongly appeals to the sensational interest of our public; however, this only stresses the need for greater endeavor. The fact that some superintendents have succeeded in their endeavor adds precedent and courage to those who wish to, and must follow.

The job of the water works superintendent has all the potential possibilities to make it one of the most important and responsible positions in the community. The degree of success attained depends on none other than the profession itself, and, particularly, the aggressiveness shown in attaining personal qualifications essential to any scheme for successfully enlisting enlightened public opinion for adequate support. Active interest in and support of the various national and state water works organizations is undoubtedly a step forward. The water works profession needs organization today, not only for informational purposes, but also that its relation and importance to the public can be established in the most forceful and effective manner possible. I believe it is no small part of a superintendent's duty to be constantly on the alert to improve his own knowledge, and to find ways and means to impress his public with the vital and important nature of his work to the safety and continued prosperity of the entire community.

In conclusion, I wish to emphasize again that the degree of success attained by the water works superintendent in his job is directly proportionate to his ability not only to manage and operate the water works system to the best advantage of his community in every respect, but also to create a public belief in, understanding of, and demand for, a water system and a superintendent of that system, that will serve the community's best interests.

Acknowledgment.—The foregoing is an abstract of a paper presented before the Missouri Valley Section of the American Water Works Association.

Los Angeles Water Development Program Advanced.—The State Supreme Court has rendered a decision approving the plan of the city of Los Angeles, Calif., to purchase five towns in the Owens Valley, Ingo County, as a part of the city's water supply development program.

Problems of Water Works Operation

A Discussion of the Relation of Politics to Water Works Management; the Business Procedure of the Office; the Awarding of Contracts; the Diversion of Water Funds; and the Welfare of Employees

By GEORGE H. FENKELL

President American Water Works Association, General Manager, Department of Water Supply, Detroit, Mich.

IN the short time available for use by the speaker, it is obviously impossible for him to allude to, much less discuss, each of the many kinds of problems which confront those who are engaged in some line of endeavor in the water works field. Questions of importance arise in every water department at frequent intervals, and it is only by careful and conscientious thought that answers can be found and policies developed which will prove satisfactory in practice.

Political Problems.—Much has been said and some things have been written with the purpose of demonstrating the harmful effects that will accrue from operating a water department for political expediency rather than to secure business efficiency. Positions of responsibility and trust in the works are sometimes filled by those who are selected because of their ability to control votes in a local election, rather than because of their business and technical qualifications. The blame for such action is laid on the shoulders of the so called "politician," who accepts the responsibility with a shrug of the shoulders, and nothing further is heard of the matter. When we consider that a politician is a person, male or female, young or old, who endeavors to secure votes for any purpose, and when we remember that the form of governments in this country and in Canada provide for the selection of the legislators and many other officials by means of the ballot, it must be apparent that until we change our form of government the politician will remain with us, and many of them, in the future, as in the past, may be expected to serve society well.

Whatever is wrong with the method of filling positions in the personnel of a public utility with politicians rather than with those particularly fitted by training and experience to do the work in hand, is the fault of the voters, and they alone can remedy the trouble. The procedure is simple. The constitution, enabling act, and charter, one or all, must provide a way that will make it obligatory that sound and efficient government be used in the department. No matter what the manager of a water works may do to develop a good plant, nor how hard he may work to operate it successfully, nor how clever he may become in winning popular support for his various projects, he can not succeed fully, and will probably fail partially, if the rules laid down for his direction are unsound.

Business Procedure.—Just as the levying of the income tax has caused many persons to become book-keepers, so the imposing of a tax on earnings has compelled the management of the privately owned public utility to maintain an elaborate system of cost accounting. In some states the public utility commissions are required to insist upon the use of uniform accounting methods in both publicly owned and privately owned utilities, while in others the former are free to determine the form of records that they will maintain.

The inventions and improvements in office appliances and accessories that have been made in the last 25 years are surprising. The use of typewriters has been of but short duration, and during the last 15 years the book-keeping machine and many kinds of calculating devices have come into favor. The improvements in office devices follow with such promptness, that few devices can be considered as being strictly up-to-date that have been in use for more than five years.

From the above we must conclude that office procedure as it exists now, has been developed because of the demand for data for fixing rates; and for levying taxes; and it has been made possible to no small degree through many improvements and mechanical inventions in office equipment.

Two years ago the members of this Association organized a Finance and Accounting Division, and at the Pittsburgh convention this division will present a program which will consist of twelve carefully prepared papers. These facts are introduced at this time to make it clear that the water works employee is giving more and more consideration to all subjects that relate to the technique of business.

The Awarding of Contracts.—Although there may be some question as to the propriety of introducing the subject here, the writer ventures to call attention to methods of procedure that should be considered in the award of contracts. The first item to be mentioned is the practice of awarding contracts to the lowest bidder. Even when a substantial bidding deposit with each proposal is required, it is believed that many engineers at least, probably a majority of them, will be found opposed to the obligatory requirement that the award of a contract must go to the lowest bidder. Many city charters, however, contain this stipulation, and it is fair to inquire whether this enforced practice is a good one, it being understood that a substantial bond will accompany each contract. A discussion of this subject leads to a consideration of "The Responsibility of the Engineering Profession for the Conduct of Public Contracts," and this was the title given an article prepared by the late Major Cassius E. Gillette, and published in the Engineering News, May 30, 1907, and commented on editorially in the same issue of that magazine. While the older members of the engineering profession will remember the discussion that the above articles engendered, they are recommended to the younger members for careful consideration. Not only at all time must public business be conducted honestly, but all transactions must appear to all interested parties to be honest and sincere.

The inclusion in specifications of arbitration clauses and means for the evaluation of bids, is common and has proven advantageous. The pre-qualification of bidders has been made possible in some states by legislation. A charge for bidding, or a bidding fee, has been proposed more recently, but judging by the opinions expressed by a number of engineers and contractors, this plan has not found much favor with those who have given the subject careful consideration.

Finally, it will be stated, that while youth will chafe under the conservative requirements imposed on their actions by the system of "red tape," one should proceed cautiously in introducing new or untried methods in governmental departments for the purchase of material or the award of contracts.

Diversion of Water Funds.—The subject, "Diversion of Water Funds," is now under consideration by a committee in this association. The municipal water works advocate will state that moneys obtained from the sale of water should be used in and by the department. The branch of the city government which levies taxes is faced with the problem of obtaining funds for various municipal purposes in those ways which are objected to the least by the taxpayers in the community. In some states it is required that no water department revenue can be diverted to other uses; in many towns the water revenue is insufficient to meet the needs of the department, and the balance needed is secured from the general tax levy; while in others the diversion of funds proceeds to a very substantial degree. Whatever may be the merits of either side of the case in hand, the report of the committee previously mentioned will be received with a great deal of interest, and even after publication it may be expected that the controversy will continue for some time to come. In the meantime, the most urgent need is that each water works executive will make strong and continued effort to secure enough income to allow his department to be maintained in a good way, and to be extended as the needs of the community demand.

Welfare of Employees.—Contented employees are essential in a well operated department. To secure this desirable condition it is necessary that adequate compensation be paid for the services performed, and this condition has been established in some places only. No panacea has been found that will solve this or any other wage question without regard to form of government, local conditions, or conditions of trade. Even that drastic method of declaring a strike, or of organizing the employees into a labor union has failed. It is only through the securing of recognition of the value to society of the services performed by the employees of a department that the wage scale can be established in an equitable manner.

Civil Service has become so well established that it needs no new arguments to sustain it. When honestly and fearlessly administered, it guarantees that in employment, promotion, demotion, or discharge, in or from a position, no preference will be shown because of the political or religious convictions of the individual affected.

Some satisfactory way should be found for rating employees so that advancement can be secured as merit for good work performed, and likewise due consideration should be given to the extended adoption of pension systems for employees.

Acknowledgment.—The above is an abstract of a paper presented April 7 at the meeting of the Southwest Section of the American Water Works Association.

SALAMANDERS AS CAUSE OF B. COLI.—Studies were made in 1929 at the laboratory of the County Board of Health of Cattaraugus County, New York, in the significance of salamanders as sources of pollution of water supplies. According to the 1929 report of the board, these studies showed that the free living salamanders present in springs and other ground water supplies give off many organisms into the water which are indistinguishable by ordinary means from colon bacilli of human origin.

College Has Experimental Water Treating Plant

Seventeen engineering seniors in the University of Florida, under the direction of Dr. C. B. Pollard, professor of chemistry, are obtaining practical experience in actual plant operation in water purification.

An experimental water plant, which has a continuous operation capacity of 6,000 gal. per day, and is one of a very few attached to American universities, was presented to the department of chemistry by the city of St. Augustine at the conclusion of a water survey conducted for that city by Prof. A. P. Black of the chemistry department, and George W. Simons, Jr., of Jacksonville.

This plant is mounted on a concrete base and consists of aerator, coke filter, mixing chambers, two large sedimentation tanks, and a rapid sand filter. It is equipped for chlorination and recarbonation of treated water. A water meter was presented by the city of Gainesville, Fla.; graded sand and gravel by the George Sand and Gravel Co. and umbrella-type filter distributing nozzles by the International Filter Co.

The plant is making it possible for university students to obtain practical experience in water purification. In conjunction with the plant is the complete control laboratory where every step in the process may be watched and controlled. In the future the plant will be used for research on problems in water softening and coagulation in addition to its use in class-room instruction.

74% of Dubuque Water Accounted For

During the year ending March 31, 1930, 74.2 per cent of the total pumpage of the water works of Dubuque, Ia., was accounted for. Of the total pumpage 63.4 per cent was salable. The following tabulation from the report of John W. McEvoy, Superintendent of Water Works, shows the uses of the accounted for water.

	Gallons
Salable Water	636,909,750
General flush of distribution system	6,500,000
Flushing 2,120 hydrants at 7,500 gal. each	15,900,000
Extension and plumbers' ditches	2,000,000
Service leaks, 136 at 100,000 gal. each	13,600,000
Six hydrants broken (30 min. at 1,000 gal. each)	180,000
Cleaning level reservoir (3 times)	1,500,000
Draining West Third Street Reservoir	4,000,000
Known leakage in West Third Street Storage Reservoir—(24,000 gal. per day)	8760,000
Meters tested at 35 gal. each	200,000
Eagle Point Station	2,000,000
By-pass from low pressure to level reservoir	2,592,000
Flushing city streets and sewers	25,000,000
Two horse fountains and 8 bubblers	8,800,000
Fire Department	8,500,000
City parks (120 days at 10 hrs.)	3,000,000
Bathing beach and athletic field	1,500,000
Ice rinks (7)	4,500,000
Free water furnished the city	51,300,000
Total accounted for	745,441,750

CENTRAL STATES SECTION MEETS IN OCTOBER.—The officers of the Central States Section of the American Water Works Association have selected Cincinnati, O., as the place for holding their next annual convention and the date has been fixed as Oct. 8th and 9th. The headquarters have not been definitely selected but this information will be announced later. The question of the programme and arrangements are in the hands of Albert S. Hibbs, Superintendent of Water Works, Cincinnati, O. B. J. Lechner, Erie, Pa., is Secretary-Treasurer of the section.

. . . EDITORIALS . . .

How Will a Severe Drought Affect Your Water Supply?

The drought of 1930 has been the worst in 75 years in many parts of America. In central Kentucky the drought has been the worst on record, according to W. S. Winn, Principal Hydroelectric Engineer, U. S. Engineer Office Cincinnati, Ohio. In the October issue of the "Monthly Weather Review" he said: "A number of cities in central Kentucky are passing through water famine in their municipal supplies. Most of them depend upon catchment reservoirs on small streams well up on the divide. Lexington, a city of 50,000, is frantically laying a water main to drain water from Kentucky River. Shelbyville has been hauling water by train from Louisville for several months." Recent newspaper reports state that unless normal rainfall returns soon, New York City will have to be rationed as to its water this summer. This may be a blessing in disguise, for it may awaken the public there to the economic necessity of universal metering of water.

The lesson to be learned from the drought is this: nearly every town and city should conduct a "water survey" that will disclose what would be the consequence were it to experience a severe drought. Droughts have a way of striking different areas at different times. Because a given region escaped a water shortage last year is no guarantee that it will be so fortunate in the future.

Unsolved Weather Problems

The editor is scheduled to read two papers on weather cycles, one in May before the Western Society of Engineers, and one in June before the American Meteorological Society. The results of four years research will be summarized in these papers, reprints of which will subsequently appear in WATER WORKS AND SEWERAGE.

Briefly stated, it has been found that each of the 10 largest visible planets produces at least three magnetic cycles that cause weather cycles, and that each one of six of the planets produces a supercyle of much greater length than the orbital period of the planet. Presumably, each of the other four planets also causes a supercycle, but the length of it is so great that neither the annual rings of the sequoias nor the annual clay varves of ancient glacial lakes have yet served to disclose these long supercycles. In addition to the weather cycles caused by the 10 largest visible planets there are similar but longer cycles evidently caused by two invisible planets whose main weather cycles are about 316 and 21,300 years respectively.

By means of cyclograms the existence of many weather cycles has been established beyond doubt. Probability calculations show odds ranging from about 1,000 to 1 to billions to 1 against accidental correlations between inferences from the planetary theory and the facts.

Each planet causes one weather cycle equal in length to its orbital period, but the peaks of the curve of this cycle are small compared with those of a cycle that is somewhat shorter than the orbital period. The latter, or main cycle, is apparently due to an upper shell of electrons encasing the planet, somewhat like the Heaviside shell that surrounds the earth. The poles of this upper magnetic field evidently revolve very slowly clockwise around the axis of the planet, thus causing them to point earthward oftener than once every orbital revolution. When the magnetic maxim of the upper and lower fields coincide, a supercycle maximum occurs. The subcycles are apparently due to permanent whirls of electrons in the upper field, having centers spaced either 30 or 45 degs. apart in longitude, somewhat like the permanent cyclones and anticyclones in the earth's atmosphere.

Fortunately the four magnetic cycles caused by each planet are perfectly harmonic, which greatly simplifies the problem. The orbital periods and magnetic cycles of any two different planets are only approximately harmonic, apparently having been perfectly harmonic when the planets were generated. Thus Saturn's main magnetic cycle of 27.82 yrs. is nearly 2.5 times Jupiter's main magnetic cycle of 11.203 yrs., and nearly 4 times the earth's supercycle of 7.000 yrs.

The editor believes that no further research is needed to establish the planetary cycles that cause weather cycles, but this does not mean that his investigations of weather phenomena have ended. Two very difficult problems remain to be more completely solved: First, the problem of ascertaining the relative precipitation effects of each of the cycles. Second, the problem of regional variations in precipitation. Why, for example, does Southern California have its maximum precipitation in January, as an average, whereas central Texas, which is in the same latitude, has its maximum in July? Why did New England's accumulated sums of precipitation departures from a mean reach a maximum about 1905, whereas those of Padua, Italy, reached a minimum about then? It is well known that many regions behave exactly oppositely in such respects, but why? The reasons given in works on meteorology do not ring true. The exceptions are almost as numerous as the instances that are supposed to conform to the alleged meteorological rules or laws.

Enough evidence has already been gathered to indicate that the weather of a given region is largely dependent upon proximity to one or more permanent whirls in the air. In short, local magnetic fields evidently play an important part.

It will not be surprising if it shall be found that mountains affect precipitation largely because of electron streams escaping from them. Electrons are nucleii upon which atmospheric moisture condenses. Hence wherever electrons are very numerous conditions are favorable to heavy precipitation. Whether it be a stream of electrons escaping from a sharp point or ridge in the earth's crust, or whether it be a permanent stratum of electrons in the atmosphere, there we should look for evidence of unusual moisture condensation.

The problems of meteorology take on a wholly different aspect when an attempt is made to solve them by electrodynamic principles instead of by thermodynamic principles. Electrodynamics has been remarkably helpful in solving the problem of weather cycles. May it not prove equally effective in solving other meteorological problems?

The Improbability of the "Highly Probable"

No great risk would be involved in betting that when a scientific author repeatedly uses the expression "highly probable" it relates to some pet theory whose truth is really quite doubtful. Such an author is Sir James Jeans. His recently published book, "The Universe Around Us," abounds in "highly probable" hypotheses about stellar matters, most of which are under debate and scarcely one of which can muster a calculated probability ratio of four to one in its favor. Sir James is a celebrated mathematician with an exhuberant imagination. Permit him to make a few assumptions and he will deduce for you a mathematically perfect "law" relating to any phenomenon in the heavens above or in the waters beneath. Will the "law" fit any facts not used in its derivation? That is another question.

Chapter IV of Jeans' book is entitled "Carving Out the Universe." It should become a classic on how not to conduct a research. In that chapter the author presents his theory of the genesis of stellar systems, and in developing that theory he makes 11 assumptions, not a single one of which is shown to have a high mathematical probability in its favor. These assumptions are:

(1) A primeval chaos of gases (p. 189).
(2) A spinning motion of many parts of the chaos (p. 195).
(3) An increase in that motion sufficient to eject equatorial gases (p. 197).
(4) A sufficiently great inequality to cause these whirls to condense and grow into stars (p. 200).
(5) That the central parts of certain stars became liquid (p. 208).
(6) That they rotate fast enough to cause fission (p. 209).
(7) That occasionally a star passes close enough to another to disrupt it without carrying away all the fragments (p. 217).
(8) That the sun acted in a similar manner on the planets, disrupting them, incidentally involving the assumption that their orbits were originally very eccentric (p. 226).
(9) That the gas filaments pulled out of the planets by the sun were cigar-shaped (p. 228).
(10) Ditto as to those pulled out of the sun by the passing star (p. 226).
(11) That some planets were originally liquid, others gaseous, and others partly liquid and partly gaseous (p. 230).

It is instructive to observe how Jeans slips in an assumption and attempt to give it plausibility by the use of the words "probable," and "likely" as an example, take the following paragraph from p. 226: "We may next turn our attention to the physical changes which must all this time be affecting the various planets. The long filament of matter pulled out of the sun is likely to have been richest in its middle parts, these parts having been pulled out when the second star was nearest and its gravitation pull strongest. Diagrammatically at least, we may think of this filament as shaped like a cigar—thick near the middle, thin at the ends—so that when condensations begin to form, those near the middle are likely to be richer than those at the ends. This probably explains why the two most massive planets, Jupiter and Saturn, occupy the middle portions in the sequence of the planets."

But he fails to point out that within this great "cigar" there is a small "cigar" composed of the planets Mercury, Venus, Earth and Mars, which is in discord with his "cigar" hypotheses. Moreover, he tacitly assumes that no planet larger than Jupiter exists in the solar system—certainly a very questionable assumption, and one given particular prominence by the recent discovery of Pluto which more than suggests that our knowledge of the solar system is still quite limited.

Jeans fails to apply a simple crucial test to his theory by deducing from it any quantitative relationship that agrees with any facts not used in framing the theory. Quantitative facts that he might have used as such tests he either ignores or brushes aside as having no significance. Why is the moon's diameter such as almost exactly to blot out the sun in a full eclipse? Why is the ratio of the mean solar distance to the planet's diameter almost exactly the same in the case of Mercury, Earth and Saturn? Why do the orbital periods of four of Saturn's satellites show such remarkable relationships; that of Tethys being double that of Mimas, and that of Dione being double that of Euceladus?

Why do all but one of the 10 larger planets conform approximately to Bode's law of planetary distances? Why do all but one of Saturn's 9 satellites conform to a similar law discovered by Proctor? Why do the inner 5 of Jupiter's 9 satellites conform to a similar law? Why are the orbital periods of all the larger planets very nearly commensurable with 500?

Jeans mentions only one of these 8 remarkable quantitative relationships, and that one he curtly dismisses thus: "So far no explanation of Bode's law has been given, and it seems more than likely that it is mere coincidence with no underlying rational explanation." It seems "likely," he asserts, but offers not the slightest evidence of likelihood. It can be shown that the odds are 14,000 to 1 against Bode's law agreeing closely with the facts by accident, so it becomes incumbent upon Jeans to prove a greater likelihood that Bode's law is without significance. Mathematician though he is, Jeans fails to utilize the mathematical tools that the principles of probability are. (In "Engineering and Contracting," October, 1930, the editor published "A Rational Explanational of Bode's Empirical Law.")

Encyclopedia Americana says of Bode's law: "Close as is the correspondence between the law and the actual distances (of the planets from the sun), no physical reason has been given to account for it, although there is little room for doubt that such exists. Kepler was the first to perceive the law and Bode argued from it that a planet might be found between Mars and Jupiter to fill up the gap that existed at that time in the series. The discovery of the planetoids (notably Ceres) has proved the correctness of this prediction."

Here, then, is a law that led to a predicition that was subsequently fulfilled, yet Jeans casts it aside, although he can point to no such proof of any of his own astronomical theories. Moreover, last March a new planet, Pluto, was discovered and its mean distance from the sun is within 3 per cent of what it should be according to Bode's law. While it is true that Neptune's distance does not fit Bode's law, it is very significant that Neptune's mean distance is almost exactly half way between that of Uranus and Pluto.

W. P. Gillette

New Equipment and Materials

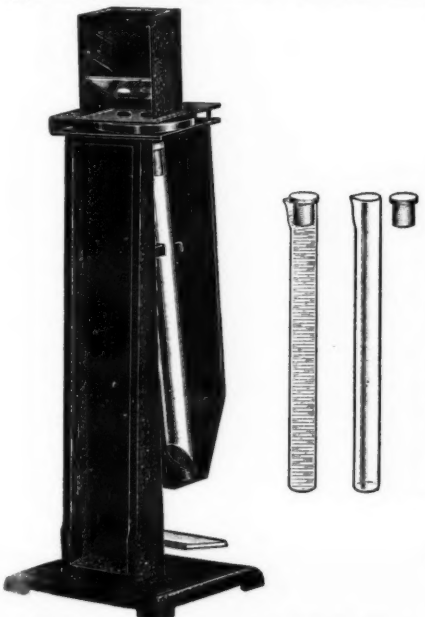
Recent Developments in Machines, Tools and Materials in the Water Works Field

New Apparatus for Analysis of Water, Sewage and Industrial Wastes

A new apparatus, noteworthy in design and simplicity, for the accurate analysis of water, sewerage, industrial wastes, hydrogen ion control and other scientific and commercial color tests has been placed on the market by Hellige, Inc., 179 East 87th St., New York, N. Y.

The Hellige Aqua Tester consists of a substantial "U" shape upright on heavy iron base. Attached to the upper part of the upright is a platform with hinged cover for holding a color disc with color glass standards for the various methods. A light shield of proper height to keep off interfering light rays, and thus facilitating the color match, is mounted on the hinged cover of the platform and has brackets for a removable mirror. The latter enables the worker to observe the color fields conveniently from a horizontal eye position. Without the mirror the observation of the color fields can be made viewing from the top vertically through the apparatus. Brackets are provided, so that the mirror can be used in different height positions, depending on whether the Nessler tubes are applied or special cells of 13 and 40 mm. liquid depth for hydrogen ion control, for higher concentrated chlorine solutions or other tests. Mounted on the lower part of the upright is a platform with two sockets for holding the Nessler tubes, and in the middle are spring clips for the same purpose. This arrangement makes it very convenient to insert and remove the filled tubes, which is a matter of a second. A large light shield is provided in front of the Nessler tubes in order to protect the solutions against direct light rays. A white opaque glass reflector serves for the illumination of the liquids in the Nessler tubes or cells.

The Nessler tubes, as offered for this apparatus, are stated to be the first ones introduced, which combine the advantage of quick filling (or emptying), and accurate adjustment of the proper liquid height. The tubes have blown glass bottoms, the outside surface of which is plane ground and polished. The open end of the filled tube is closed with a short, solid glass plunger with plano-parallel ground and polished ends, and automatically adjusts the proper liquid height of 250 mm. Special cells with 13 and 40 mm. liquid depth are supplied for hydrogen ion control and various other tests.



Hellige Aqua Tester; Nessler Tubes at Right.

The color glass standards are conveniently arranged in a circular frame of almost unbreakable material, thus forming the "color disc." By revolving this disc the proper standard is brought into the observation field. The color discs are of convenient size, 85 mm. (3½ in.) in diameter.

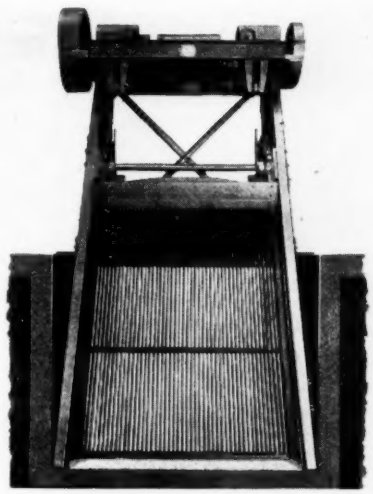
Working with the Hellige Aqua Tester is very simple. In fact it is stated to be so simple that tests can be made without any special training after a few minutes studying of the directions. The reading of the results obtained with this apparatus is simplified to such an extent that errors are impossible. No readings from tables or calculations are necessary. After one Nessler tube or cell is filled with the test solution with added reagent or indicator solution the other tube or cell is filled with plain water or test solution without reagent or indicator solution, for balancing the color fields in cases when the test solution has an original color or is turbid. The use of two Nessler tubes or cells is a special feature of the Hellige Aqua Tester and other Hellige Comparators. This arrangement allows to make tests with clear solutions as well as highly colored or turbid liquids. After both tubes or cells are put in the apparatus, the color comparison can be made quickly, by revolving the color disc with the standards until the colors match in both fields, or the test solution is found to have a color between two adjacent standards. In this color disc position the result is read directly from a number appearing through an opening in the hinged color disc cover on top of the apparatus.

New Sewage Screen

The straight-line sewerage screen, a recent product of the Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa., consists of a rack made up of steel bars, usually set vertical or at an angle of about 60° with the horizontal. The clear openings between bars may be from ⅝ in. up, depending on requirements; and the screens are made of any width from 3 ft. up to 15 ft., or more if desired.

The rack is cleaned by a rake, secured to a carriage, which travels back and forth over the screen bars. On the upward travel the rake engages with the rack and carries the accumulated solids up to the top of the screen. As the rake passes the top of the screen, a scraper cleans off the adhering solids into a trough or conveyor. It is then carried back, clear of the rack, to the bottom of the screen, where it is again lowered into engagement with the bars, for a repetition of the operation.

The speed of the rake is approximately 7 ft. per minute. By means of a time relay the rake is stopped at the highest and lowest position for half a minute. This time may be varied up to 30 minutes, to suit local conditions.



Link-Belt Straightline Sewerage Screen, Showing Rake Swung Back From Screen on Downward Travel.

The outstanding feature claimed for this machine is its ruggedness; very heavy solids may be handled by it without any damage to the machine. Ample safety devices are provided to stop the machine if boards or any other heavy material should become jammed between the racks. Means are provided for adjusting the rakes in relation to the screen so that rakes do not ride on the screen.

One set of machinery can drive several units. If two units are used, the carriages are counterbalanced, one going up, while the other one comes down.

Link-Belt Sewage Treatment Plant Book No. 642 describes the unit. This book will be sent upon request.

Orthotolidin Test Controls Chlorine in New W & T Chlorinator

An entirely new principle in automatic control of chlorination—developed by Wallace & Tiernan research engineers—is discussed in a paper, "Operating Experiences with a New Automatic Residual Chlorine Recorder and Controller," read before the recent annual convention of the A. W. W. A. It has been reprinted as Technical Publication No. 135 and copies may be had by writing Wallace & Tiernan Co., Inc., of Newark, N. J.

The orthotolidin test, generally accepted as the criterion of correct chlorinator operation, positively controls chlorine flow with this apparatus. The tests are automatically made at ten minute intervals and "residual chlorine" of the treated water recorded on a chart.

Any fluctuations in flow or chlorine demand are reflected in varied "residuals" and immediately compensated for by the automatic controller. Recorded "residual chlorine" curves show no appreciable lag between chlorine demand and automatic adjustment of chlorine flow.

This apparatus is available as a full automatic "residual chlorine" controlled automatic chlorinator or the residual recording unit may be secured separately and used in conjunction with existing chlorinator equipment.

Crawler Mounted Full Revolving Crane

The Loadmaster crane which is manufactured by Frederic H. Poor, Inc., New York, has been adapted to use with the Model GH Trackson McCormick-Deering.

The bull wheel for swinging the boom is power-driven, and is equipped with a brake so that the boom may be set at any angle desired over the front or sides of the tractor. Also, the speed of the boom's swing is controlled by the operator.

Loadmaster Crane Mounted on Heavy Duty Trackson McCormick-Deering Crawler Tractor.

With the standard 10-ft. boom the Loadmaster has a maximum lifting height of 12 ft. 4 in. under the hook; with the boom lowered, it has a maximum outreach of 10 ft. from the center of the mast in any direction. Where unusual conditions require a higher lift or greater outreach, special booms can be furnished by Frederic H. Poor, Inc.

The crane does not interfere with the use of the tractor for drawbar work. Information about this equipment can be obtained from the Trackson Co., 1320 So. First St., Milwaukee, Wis.

W-K-M Side Boom for Allis-Chalmers Tractors

W-K-M side boom units are now available for Allis-Chalmers "35" track-type tractors and Ind"U"strial wheel-type tractors. The W-K-M Side Boom Unit is a fast, powerful machine for handling pipe. It also performs equally well with dragline or clamshell bucket, drag board, orange peel bucket, or the magnet.

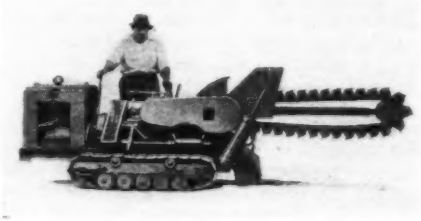
Its oscillating boom has a swinging arc of 160 degrees, which makes the unit extremely versatile. Its installation is simple and leaves the drawbar unobstructed. The machine is equipped with ball and socket joints to absorb distortions due to track oscillation.

New Ditcher for Small Ditching Work

The great amount of hand work required in digging ditches for laying small pipe brought about the development of the Little Goldigger by the C. H. & E. Division of National Equipment Corporation, Milwaukee, Wis. Designed and developed to dig a trench from 3 in. to 6 in. wide, the C. H. & E. Goldigger is stated to have a wide utility range for digging gas service connections, high pressure gas lines, small oil pipe lines, ornamental lighting cables, telephone cables, sprinkling and drain pipes in golf grounds and airports, and in any other underground work that requires a trench up to 6 in. in width and 48 in. in depth.

Digging speeds vary from 1 to 6 ft. per minute. Two speeds are available without changing sprockets and 36 speeds may be had by changing sprockets. Full multiplane traction with very low ground pressure permits operation on wet soil without miring and on lawns and parkways without injury to the grass.

Operating levers have been centralized on one side of the Goldigger for convenience of the operator in keeping his machine digging to the best advantage at all times. It can be used in very small spaces and its narrow width will allow it to pass buildings, trees, electric light and telephone poles, where the clearances are small.



C. H. & E. Ditcher

Rugged construction has been well balanced throughout the machine. All parts are built for severe and continuous service—gears and sprockets are of steel properly heat-treated—gears are enclosed in gear cases and run in oil. The oil in the main gear case is used for the hydraulic boom lift and is circulated back over the top of the gears in the case, giving them a continuous oil bath. A 4-cylinder, 12-hp. engine provides power.

Chlorinator for Small Water Works

A chlorimator designed to handle small amounts of chlorine for small water supplies has been developed by Wallace & Tiernan, Newark, N. J. It is stated that not only does the machine accurately control the small amount of chlorine necessary but its simple construction is readily understood by the practical water works men. All control parts are on the outside and a removable hood makes possible complete inspection at any time.

W. & T. Chlorinator

Reliefs are provided to prevent moisture being drawn back into the chlorine gas control parts, and also to prevent escape of gas into the room in the event of accidental failure of the auxiliary water supply operating the equipment. The machine is also adapted to the small sewage disposal plant. Technical Publication Number 74 of the Wallace & Tiernan Co., Newark, N. J., gives specifications and descriptions of the equipment for small water supplies. Copies will be sent on request.

Monarch Tractor Equipped with W-K-M Handling Pipe for Natural Gas Line

Manufacturer of nationally advertised construction equipment offers an excellent opportunity to experienced equipment salesmen to start in their own business. Very little capital required. Several important cities now open for immediate action. Full particulars. Address, Box 1637, c/o Roads and Streets, 420 Lexington Ave., New York City.

DISTRIBUTOR NEWS

The Distributor's Department in the Gillette Construction Group

Tanner Assets Acquired by Wallace & Tiernan

Announcement has been made of the acquisition of the assets of the Tanner Engineering Company of Long Island, New York, by the Wallace & Tiernan Company. The purchasing company will carry on the manufacture and sale of Tanner instruments.

The Tanner indicators and recorders indicate and record variations in liquid levels, vertical movements of gas holders, positions of valves and sluice gates or any straight line or angular motion, at any distance from the point of measurement. Use of such instruments transmits knowledge of water storage conditions directly to pumping station or water superintendent's office, and furnishes records of day by day changes making accurate future planning possible and eliminating unforeseen shortages. Tanner instruments are said to measure and record as little as $\frac{1}{32}$" movement.

The instruments will be manufactured in the Wallace & Tiernan, Belleville, New Jersey, factory. They will be distributed through the forty-two district offices maintained throughout the country by the manufacturer, where technically trained engineers are prepared to assist in solving problems entailing measurement of motion at points remote from the place at which it is desired that these movements be indicated and recorded.

Worthington Pump Notes

E. J. Schwanhausser, Works manager of the Buffalo Works of the Worthington Pump and Machinery Company, Harrison, New Jersey, recently announced the promotion of John A. Mair to the newly established position of field engineer, and of the appointment of A. F. Beres as personnel manager at Buffalo.

Mr. Beres, according to news report, comes to Worthington to represent the management of the Buffalo works in various phases of industrial relations; also employment, cafeteria, safety programs and Benefit Association activities. He has lived in Buffalo since 1900 and has been engaged in personnel work all of that time. He has been associated with the Niagara Machine & Tool Works, Republic Metalware Company, American Brass Company and the U. S. Light and Heat Company. Mr. Beres was born in New York City, and educated at Warren, Pa.

John A. Mair, since 1923 a member of the Buffalo works staff, has served as foreman of the two-cycle Diesel engine erection floor since 1929. His new duties, it is said, will include periodic visits to plants where Buffalo works products are in use or are being installed. Mr. Mair is a native of Scotland, where he acquired a varied experience in engineering and construction work. By the time he was 24 years old he had completed a five-year apprenticeship at one of the famous shipyards on the River Clyde, and was made foreman in charge of the installation of machinery in British warships.

During the war Mr. Mair was considered a key man on British Admiralty work. He took part in the sea trials of several war vessels, which included the first steam-driven submarine ever built.

Mr. Mair joined the Worthington organization the day after he landed in the United States.

New Chicago Distributor for Byers

The Superior Construction Equipment Company will distribute and service the complete line of 1¼ to ½-yd. shovels, cranes, draglines, trenchers and skimmers for the Byers Machine Company, of Ravenna, Ohio. They will also handle the Byers Excavator Company line of Model 40 and 50 small shovels and cranes.

The entire sales force of the Superior Construction Equipment organization, including President Sostheim, recently visited the Byers factory for a week-end. They saw the complete line of machines in action out on the proving grounds, went through the factory on an extended inspection tour and later were given an intensive study course covering equipment, service and general company policies.

During the past eleven years the Superior Construction Equipment Company, headed by W. R. Sostheim, president, has successfully distributed a complete line of construction equipment to all classes of the construction industry as well as to industrial plants, public utilities, railroads, municipalities, states and the government. Their large warehouse holds stock of all the most popular equipment for immediate shipment from their own railroad siding.

Offices and warehouse are at 1850 Kostner Ave., Chicago, Ill.

W. R. Sostheim, President of Superior Construction Equipment Company, Chicago, Ill., and N. C. Beckwith, President of the Byers Machine Company, Ravenna, Ohio, Shaking Hands on Their New Relationship. Mr. Sostheim and His Organization Will Represent Byers in the Illinois and Indiana territory

Barber-Greene Company Announces Organization Changes

Several changes in the sales organization lineup for 1931 have been announced by the Barber-Greene Co. of Aurora, Illinois, manufacturers of material handling equipment.

E. H. Cooper, since 1927 manager of the Barber-Greene Co. of Kansas City, has been appointed ditcher line head for the Western Division to operate with J. M. Bruns, ditcher line head for the Eastern Division. Mr. Cooper has been with the Barber-Greene Co. since 1925. In that year and in 1926 he was in Florida where he introduced the vertical boom ditcher for subdivision work. Since joining with the Barber-Greene Company, Mr. Cooper has studied and worked with ditching problems especially, and has had very extensive experience with all types of ditching, particularly with pipe line work in Oklahoma, Kansas, and Missouri.

The territory formerly served by Mr. Cooper as manager of the Kansas City office of Barber-Greene Co. is now divided between the Kenney Machinery Co. of 2301 Grand Avenue, Kansas City, Mo., and the Buda Engine Service of 521 West Archer St., Tulsa, Okla.

Two new branch managers are also announced by the Barber-Greene Company. They are Frank Ness, manager of the Philadelphia office and D. H. McLean, manager of the Cleveland office. Mr. Ness received his education at Clark University, Worcester, Mass. He has been with the Barber-Greene Co., at its Boston office, for five years, during which time he has received a very thorough and practical training in the construction and uses of B-G equipment. Prior to his present connection Mr. Ness spent 8 years in the belting and power transmission industry, with the Lewis E. Tracey Co. of Boston, and the Fairbanks Co. of New York.

Mr. Ness also served two years with the Base Hospital Unit No. 5, the first American outfit to go to France.

D. H. McLean, manager of the Cleveland branch office, was graduated from the University of Colorado in 1924 and after coaching football for two years, entered the Detroit branch office of Barber-Greene after several months experience at the home plant. His training in the factory and field have equipped him to understand and solve materials handling problems.

Pioneer Companies of Pacific Coast Merge

Victor Welding Equipment Co., with headquarters and plant at San Francisco, California, makers of the nationally known Victor Welding and Cutting Equipment and the Kimball-Krogh Pump Co. with plants at Los Angeles and San Francisco, California, have been merged into the Victor Equipment Co. Both Victor Welding Equipment and Kimball-Krogh Pumps will continue to be sold under their well known trade marks and the two original companies will be operated as individual divisions by the newly formed "Victor Equipment Co."

The object of this merger is to strengthen the engineering and research facilities; to enlarge the domestic and foreign sales fields; to consolidate and expand warehousing, trucking, and delivery service. A considerable reduction in overhead expense is anticipated because of unified management, co-ordinated advertising, and the utilization of the combined engineering skill of the newly formed company.

An analysis of the major users of the products of the pump division and of the welding equipment division discloses the interesting fact that both of the former institutions have sold and given service to the same major groups of industries.

Since 1877 pumps of the Kimball-Krogh division have been marketed internationally. The total line of Kimball-Krogh pumps includes centrifugal deep well turbines, direct flow deep well turbines, horizontal centrifugals up to 100,000 gallons per minute, booster and circulating pumps, mine unwatering pumps, mine station pumps, tailings and sand pumps, vertical pit pumps, dredge pumps, etc.

Victor Welding Equipment has been a pioneer of a new industry which to-day has become one of the largest in America and without which the construction of modern pipe lines, construction or dismantling of ships, maintenance of railroad equipment and tracks, repair of broken machinery, design of modern steel structures, would have been impossible.

The Victor Equipment Co. will be under the management of the men who have contributed so materially to the splendid development of the two companies involved in this merger. L. W. Stettner as President will be assisted by E. L. Mathy as Vice President in charge of sales promotion and advertising, Geo. Pennington as Vice President and General Manager of the Kimball-Krogh division, Ronald Schlegel as Vice President and assistant to Mr. Pennington, and by Mr. Wm. Fulwider, Secretary, in charge of Accounting.

With three factories and three company owned stores and warehouses, trucking and installation facilities, the new company's ability to render prompt and efficient service will be assured.

Busch-Sulzer Erects New Shop

Busch-Sulzer Bros. Diesel Engine Company of St. Louis, Missouri, through their Board of Directors, has authorized the construction of a new erecting shop, suitable for testing diesel engines of large sizes up to 25,000 horsepower, and an extension of the iron foundry with a 75 ton craneway. W. J. Knight & Company, Engineers, have been retained to draw plans and supervise the work, according to recent announcement.

Recent orders of this company includes: seven Busch-Sulzer diesels all larger than 1,000 H. P., including 1—4,000 H. P. for the Tucson plant of the Federal Light and Traction Company, 1—3,000 H. P. for the Public Service Company of Colorado, a Cities Service Utility, and 1—3,000 H. P. for Freeport, New York. It is said several sales negotiations in hand include large diesels of from 4,000 to 8,000 H. P. for public utilities.

Western Distributor Holds Annual Sales Meeting

The sales and service division of the Edward R. Bacon Company recently met at the headquarters in San Francisco for the 21st annual sales conference. This company is one of the largest distributing agencies on the coast and at the opening meeting Mr. Bacon, who founded the company in 1910, traced the growth of construction in the far west and the parallel growth of his company.

A banquet was held at the St. Francis Hotel at which reports of the year were given by divisional managers, and major projects, such as Boulder Dam, and Golden Gate Bridge were discussed. The consensus of opinion was that, as a whole, construction, suffered less than any other basic industry during the late depression, and that 1931 holds great promise. The total sales for 1930 were reported as closely approaching the high mark set in 1929, and the addition of a new service department, that of lubrication maintenance has been announced as one evidence of faith in the outlook for 1931. In the face of a general drop in production this organization was able to maintain its personnel intact during the past year.

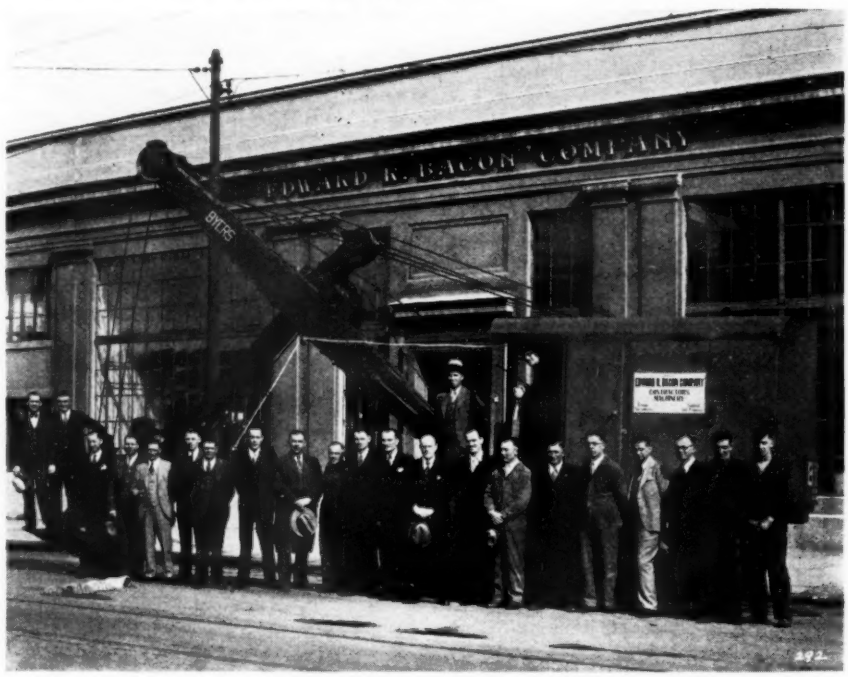
The Edward R. Bacon Company started with an office and warehouse of only 3,200 square feet in area, and now uses over 100,000 square feet in sales and show rooms, warehouses, parts, repair and shipping departments and yards for used equipment. Branch offices are maintained in Oakland, Sacramento, Fresno, Reno, San Jose and Honolulu. Several types of construction equipment are manufactured under their trade name of ERBCO, and the equipment of over fifty nationally known manufacturers is carried in stock.

It is said that the Jaeger Machine Company, in 1913, shipped to Edward R. Bacon Company the first carload of concrete mixers that ever left its plant. The Foote Company, manufacturers of Multifoote Pavers, was the first manufacturer to be represented by them. Both of these manufacturers are included in their present list.

Paradon Makes Foreign Appointments

The Paradon Company of Arlington, New Jersey, manufacturers of chlorinators, ammoniators and dry chemical feeders announces the appointment of the following foreign agents: F. Hegenbarth, La Ceiba, Rep. de Honduras; Compania de Machinas de Brazil, Caixa Postal 377, Recife Pernambuca, Brazil and Caixa Postal 2224, Rio de Janeiro, Brazil; Antiga & Company, Apartado 1052, Havana, Cuba; Manuel J. Riguero & Co., Ltd., Manague, Nicaragua.

Lincoln Electric Company, Cleveland, Ohio, manufacturers of Stable-arc welders and Linc-weld motors, announces the removal of the Chicago office to a new building at 1455 West 37th Street, from 53 West Jackson Boulevard. The move will give increased facilities for storage, sales and service.



Bacon Company Personnel

Edward R. Bacon, president, at controls of machine with A. B. Hartley, vice-president, beside him. The others from left to right: Don M. Hoffman, manager, Sacramento division; Paul W. Mohr, sales manager; S. J. Clark, assistant sales manager; O. C. Bell, manager, Reno division; H. J. Learn, manager, Fresno division; F. Moran, secretary, Contractors' Machinery Exchange; S. B. DeHart, sales engineer; Niles S. Colman, advertising manager; Sam Bates, superintendent, Contractors' Machinery Exchange; Frank Wies, transportation superintendent; W. M. McGouirk, sales manager; Claude L. Hunt, lubrication engineer; F. Stebinger, secretary and treasurer; W. J. Drury, service manager; John Lyons, field service; Charles S. Jackson, manager, San Jose division; John Baumgartner, service department; J. Jorgensen, manager, Contractors' Machinery Exchange; H. G. Thiele, manager, Oakland division; Will Ronayne, service department; Frank Kern, shipping department.